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500 Boylston Street Project

Traffic, Shadow, Wind and Subsurface Studies for the Reduced Eastern Component

October 1987

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Note Fallouts

Submitted to Boston Redevelopment Authority

Submitted by A Joint Venture of
New England Mutual Life Insurance Company
Gerald D. Hines Interests, Inc.

Prepared by Vanasse Hangen Brustlin, Inc.
Wright Brothers Facility, MIT
Haley & Aldrich, Inc.
Skidmore, Owings & Merrill

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TRAFFIC, SHADOW, WIND AND SUBSURFACE STUDIES FOR THE REDUCED EASTERN COMPONENT 500 BOYLSTON STREET BOSTON, MASSACHUSETTS

Submitted to
BOSTON REDEVELOPMENT AUTHORITY

Submitted by
NEW ENGLAND MUTUAL LIFE INSURANCE COMPANY
GERALD D. HINES INTERESTS, INC.

Prepared by

VANASSE HANGEN BRUSTLIN, INC.
WRIGHT BROTHERS FACILITY, MIT
HALEY & ALDRICH, INC.
SKIDMORE, OWINGS & MERRILL

OCTOBER, 1987

0875/1087/wpr-ES5

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INTRODUCTION

This document is an addendum to the BRA Draft and Final Environmental Impact Reports submitted in October 1984 and February 1985, respectively. The term "500 Boylston Street Project" refers to the twin tower building described in these BRA Environmental Impact Reports. The term "Reduced 500 Boylston Street Project" refers to the building described in this addendum report. This project consists of two components, referred to as the "Eastern Component" and the "Western Component."

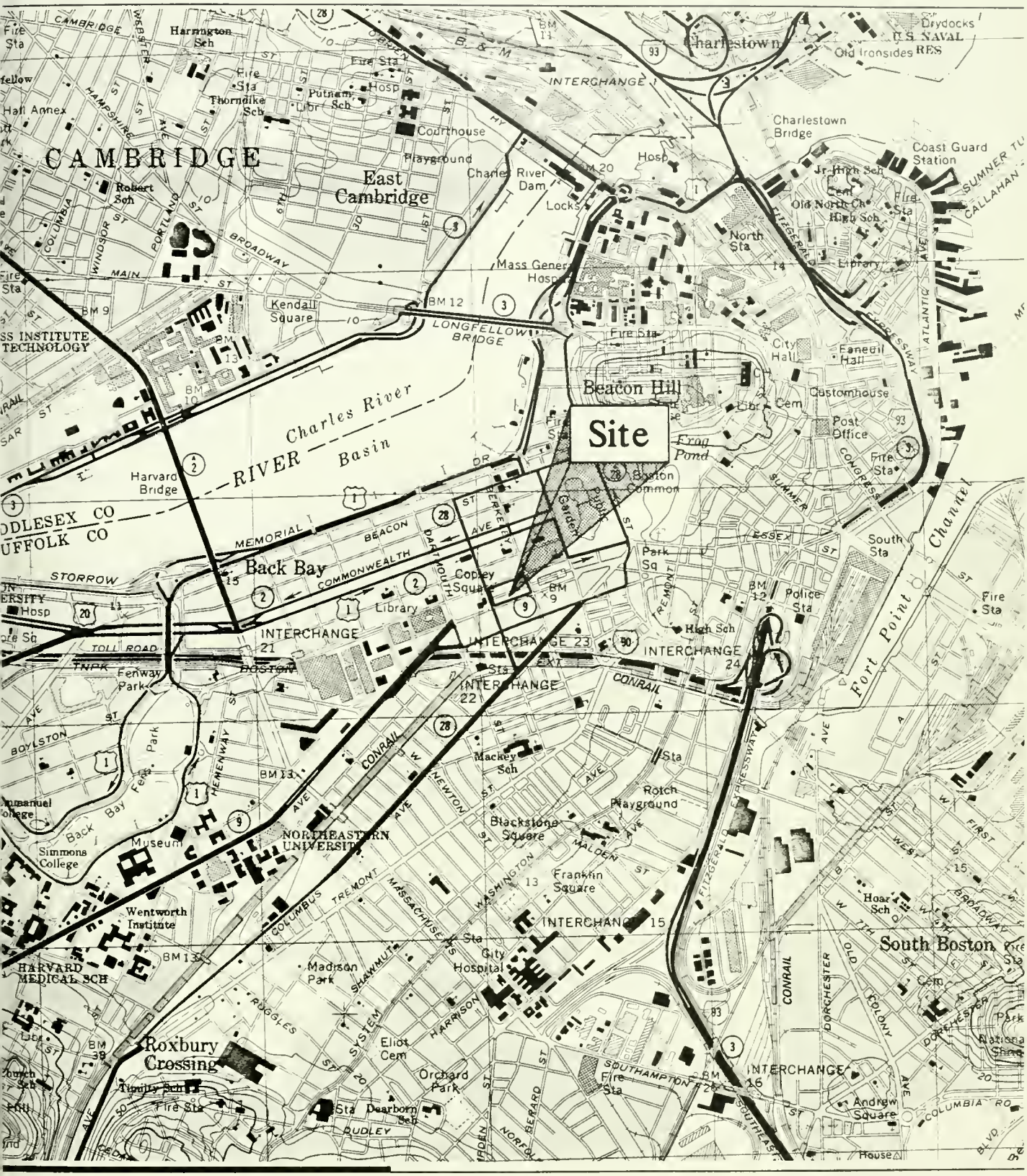
This report presents traffic, shadow, wind, and subsurface technical studies for the Reduced 500 Boylston Street Project. Including this introductory chapter, the technical studies report contains several chapters which discuss the Reduced 500 Boylston Street Project. Site and Area Description presents a brief description of the context of the Project site. Technical Issues presents the technical analysis for traffic, shadow, wind and subsurface issues.

A. DEVELOPMENT ALTERNATIVES

1. 500 Boylston Street Project

The purpose of including this previous proposal in this technical studies report is to provide an alternative by which to compare the Reduced 500 Boylston Street Project in terms of traffic, shadow, and subsurface conditions.

The 500 Boylston Street Project consists of a full-block integrated plan for an active, 1.3 million square foot, commercial development in Boston's Back Bay (see Figure I-1). A six-story base fronting on Boylston Street provides approximately 100,000 square feet of retail and commercial space. The two



Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

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Site Location

Fig. I-1

towers, rising 19 stories from a six-story base (for a maximum project height of 25 stories) will accommodate most of the 1.2 million square feet of office space. The two towers will be situated on the southern portion of the site, along St. James Avenue.

Pedestrian open areas will include the sidewalks along Clarendon Street, St. James Avenue, a portion of Berkeley Street which will be widened and two plazas opening on to Boylston Street. An underground parking garage with space for up to 1,270 cars will have access from St. James Avenue and Clarendon Street and egress from St. James Avenue and Berkeley Street.

2. Reduced 500 Boylston Street Project

The Reduced 500 Boylston Street Project will establish a 1.2 million square foot, active commercial development consisting of 1,100,000 square feet of office and 100,000 square feet of retail space. Pedestrian plazas and below-grade parking for up to 1,270 cars will be provided.

The Western Component of the Reduced 500 Boylston Street Project is a modification of the twin tower, 500 Boylston Street Project. The Western Component tower rises 19 stories above a six-story base on the Clarendon Street portion of the site, and is currently under construction. The Berkeley Street, or Eastern Component, consists of a 22-story tower. The new tower is positioned so that its main facade fronts on Berkeley Street while the Western Component, fronts on Boylston Street.

The Reduced 500 Boylston Street Project differs from the 500 Boylston Street Project in several ways. The Eastern Component has been redefined to include 100,000 square feet less office space. Its height is 30 feet shorter and its pedestrian entrance

is on Berkeley Street. The Eastern Component's facade is set back further from Berkeley Street than the base of the 500 Boylston Street Project. The below-grade parking garage has been redesigned to eliminate the 500 Boylston Street Project egress onto Berkeley Street. The exit onto St. James Avenue will be retained.

B. PROPONENT

A joint venture of New England Mutual Life Insurance Company (The New England) and Gerald D. Hines Interests, Inc.

C. SUMMARY OF TECHNICAL ISSUES

The environmental effects of the Reduced 500 Boylston Street Project are briefly described below. Chapter III should be referred to for a more detailed discussion of these issues.

1. Traffic

Traffic analyses of the Reduced 500 Boylston Street development program and the proposed deletion of the Berkeley Street exit driveway indicate that these modifications will have a small effect on traffic in the Back Bay community compared to the 500 Boylston Street Project. Of the twenty-three analysis locations, ten show some change in V/C ratio, with five increasing and five decreasing. Only two locations show a significant change. At Boylston Street/Berkeley Street, the V/C ratio decreases from 0.98 (LOS "E") to 0.90 (LOS "D") and at St. James Avenue/ Clarendon Street, it increases from 0.75 (LOS "C") to 0.86 (LOS "D"). Additional analyses were performed for several alternative development programs including varying amounts of office, hotel, residential and retail space. The results indicate that, no matter how the total project is physically configured, there

is little real difference in traffic operation on Back Bay intersections, and that the impacts can be lessened through measures described in the BRA Environmental Impact Reports. Additional short-term traffic diversion measures are also proposed herein to respond to continuing concerns on the part of Back Bay representatives about general traffic flow patterns through the neighborhood, as well as the Reduced 500 Boylston Street Project's potential for adding new trips to certain residential streets.

2. Shadow

A series of computer-generated shadow analyses have been performed which involved overlaying the 500 Boylston Street Project shadow studies with the Reduced 500 Boylston Street Project shadow studies to identify the differences between the shadows cast by the two buildings. The development of the Reduced 500 Boylston Street Project eliminates large areas of winter shadow as compared to the 500 Boylston Street Project and results in only small amounts of additional spring, summer and fall shade.

3. Wind

To quantify the pedestrian-level wind environment surrounding the project site, a detailed wind tunnel test was conducted for the Reduced 500 Boylston Street Project using the hot-wire technique. In general, the data analysis revealed a build condition with relatively comfortable pedestrian level winds. Of the twenty-eight stations tested, only eight stations exceeded the BRA criteria for equivalent average wind velocity. Five of the eight stations, those nearest the John Hancock Tower, exceeded the BRA criteria when tested prior to commencement of project construction.

4. Subsurface Conditions

The Reduced 500 Boylston Street Project foundations, below-grade parking structure and construction procedures are essentially the same as anticipated for the 500 Boylston Street Project and the Western Component which is currently under construction. Based on excavation performance during construction of the Western Component, the geotechnical issues discussed in the BRA Environmental Impact Reports are applicable to the Eastern Component Project.

SITE AND AREA DESCRIPTION

The 3.15-acre project site comprises the block bounded by St. James Avenue and Clarendon, Boylston and Berkeley Streets (see Figure II-1). The site was created as part of the original Back Bay landfill and grid development of the mid-nineteenth century.

The block to the west of the site is Copley Square, the location of Trinity Church, while the block to the east, across Berkeley Street, includes the Berkeley Building and other commercial and retail buildings. To the north, the land and buildings fronting Boylston Street are owned by The New England. To the south, across St. James Avenue and between Berkeley and Clarendon Streets, stand the John Hancock's Berkeley Tower and Clarendon Buildings. The site currently consists of the Western Component of the Reduced 500 Boylston Street Project plus three remaining, partially occupied buildings.

The 500 Boylston Street Project site is situated in the Back Bay, which is characterized by a mix of historic and contemporary buildings. Districts neighboring the site include the residential South End Community to the south and to the southeast, Park Square, which consists of office, retail and hotel uses.

SOURCE: Skidmore, Owings & Merrill

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Consulting Engineers & Planners
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Site Context

Fig. II-1

TECHNICAL ISSUES

A. TRAFFIC

1. Introduction

BRA Draft and Final Environmental Impact Reports were prepared for the 500 Boylston Street Project in 1984 and 1985, respectively. They included traffic analyses for an extensive area of the Back Bay and South End, based on an anticipated two-phase development program culminating in 1989. The Western Component portion of the program is now under construction. The Eastern Component, however, has been redefined to include 100,000 square feet less office space and a design which deletes the original garage egress onto Berkeley Street. This results in a revised full build program of 1,200,000 square feet of space distributed between office and retail uses and between the two components as shown in Table III-A-1. It also results in a new traffic circulation pattern out of the Project garage, which now includes one exit onto St. James Avenue. The original entrance pattern of inbound driveways on both Clarendon Street and St. James Avenue is not affected by any Eastern Component changes.

TABLE III-A-1
REVISED DEVELOPMENT PROGRAM
REDUCED 500 BOYLSTON STREET PROJECT (GROSS SF)

Use	Western Component	Eastern Component	Total
Office	647,600	452,400	1,100,000
Retail	71,300	28,700	100,000
Total	718,900	481,100	1,200,000

The purpose of this section is to identify the traffic impact changes which can be expected to result from the Eastern Component development program and from deletion of the Berkeley Street Garage egress. Also documented are additional analyses of various alternative Eastern Component development scenarios which have been investigated to identify their potential for reducing traffic impacts beyond the Reduced 500 Boylston Street Project. Finally, traffic diversion measures are proposed which are designed to minimize further the effects of traffic impacts on certain Back Bay streets.

2. Traffic Analysis of The Eastern Component Program

The procedure used in this revised traffic analysis was to retain all of the trip generation, distribution and assignment assumptions described in the BRA Environmental Impact Reports, to apply these assumptions to the 100,000 square feet of office space reduction, deduct the resulting vehicular trips from the roadway system, reassign the traffic component originally exiting the project at Berkeley Street to St. James Avenue, and recompute the volume/capacity (V/C) ratios and levels of service at the original study area locations. Since most of the change results from eliminating the Berkeley Street Garage exit rather than the office space reduction, only the PM peak hour condition was analyzed. There would be no change at all in the AM peak hour since inbound garage movements are not affected by Eastern Component changes. Table III-A-2 summarizes the results. For comparison purposes, it repeats the estimated traffic impacts for existing conditions, 1989 No-Build, and the 500 Boylston Street 1989 Build condition based on 1,300,000 square feet. It then presents the revised results for 1,200,000 square feet of development, both with and without the Berkeley Street Garage exit. The results are presented in this way to isolate the separate effects of the office space reduction and the garage egress

TABLE III-A-2
TRAFFIC ANALYSIS RESULTS FOR WEEKDAY PM PEAK HOUR UNDER VARIOUS CONDITIONS

Intersection	Existing		1989 No-Build		1,300,000 SF With Berkeley St. Garage Exit* 1989 Build		1,200,000 SF With Berkeley St. Garage Exit 1989 Build		1,200,000 SF Without Berkeley St. Garage Exit** 1989 Build	
	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
Beacon/Clarendon	0.36	A	0.37	A	0.38	A	0.38	A	0.38	A
Beacon/Berkeley	0.75	C	0.93	E	0.98	E	0.98	E	0.97	E
Beacon/Arlington	0.57	A	0.58	A	0.58	A	0.58	A	0.58	A
Beacon/Charles	0.80	C	0.80	C	0.80	C	0.80	D	0.80	D
Commonwealth/Dartmouth	0.48	A	0.51	A	0.57	A	0.57	A	0.61	B
Commonwealth/Clarendon	0.52	A	0.62	B	0.62	B	0.62	B	0.63	B
Commonwealth/Berkeley	0.67	B	0.80	C	0.88	D	0.87	D	0.86	D
Commonwealth/Arlington	0.49	A	0.49	A	0.49	A	0.49	A	0.49	A
Boylston/Dartmouth	0.57	A	0.63	B	0.63	B	0.63	B	0.65	B
Boylston/Clarendon	0.63	B	0.67	B	0.67	B	0.67	B	0.67	B
Boylston/Berkeley	0.76	C	0.90	D	0.98	E	0.97	E	0.90	D
Boylston/Arlington	0.66	B	0.60	A	0.63	B	0.62	B	0.60	A
Boylston/Charles	0.42	A	0.71	C	0.72	C	0.72	C	0.72	C
St. James/Dartmouth	0.65	B	0.80	C	0.86	D	0.86	D	0.86	D
St. James/Clarendon	0.60	A	0.66	B	0.75	C	0.75	C	0.86	D
St. James/Berkeley	0.73	C	0.82	D	0.84	D	0.84	D	0.84	D
Stuart/Dartmouth	0.40	A	0.51	A	0.52	A	0.52	A	0.52	A
Stuart/Arlington	0.92	E	1.04	E	1.09	E	1.09	E	1.11	E
Columbus/Dartmouth	0.51	A	0.55	A	0.57	A	0.57	A	0.57	A
Columbus/Clarendon	0.58	A	0.65	B	0.74	C	0.74	C	0.74	C
Columbus/Berkeley	0.47	A	0.47	A	0.51	A	0.51	A	0.51	A
Tremont/Berkeley	0.76	C	0.76	C	0.76	C	0.76	C	0.76	C
Tremont/Arlington	0.75	C	0.81	D	0.85	D	0.84	D	0.84	D

* 500 Boylston Street Project
** Reduced 500 Boylston Street Project

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change. As demonstrated in the table, the office space reduction alone has only a very small impact. Of the twenty-three locations analyzed, only four showed any change in level of service.

Changes in impacts between the Reduced 500 Boylston Street Project and the 500 Boylston Street Project can be derived by comparing the appropriate columns in Table III-A-2. Of the twenty-three analysis locations, ten show some change in V/C ratio under the combined scenario with 100,000 square feet less office and without the Berkeley Street Garage exit. The ratio increases at five locations and declines at five. Only two locations experience a significant change. At Boylston/Berkeley Streets, the V/C ratio decreases from 0.98 (LOS "E") to 0.90 (LOS "D"), while conditions worsen at St. James Avenue/Clarendon Street from 0.75 (LOS "C") to 0.86 (LOS "D"). The other eight locations with different V/C ratios show small changes (up or down) ranging from 0.01 to 0.04. Figure III-A-1 summarizes the information in graphic terms. It should be noted that neither Table III-A-2 nor Figure III-A-1 include the benefits of the mitigation measures recommended in the BRA Environmental Impact Reports.

The proposed changes in the Eastern Component of the project will have a generally beneficial effect on traffic in the Back Bay community. Most of the impact will occur from deleting the garage exit on Berkeley Street. This will force certain traffic movements to occur in a different way than they would with the Berkeley Street Garage exit in place, as under the 500 Boylston Street Project, since all garage traffic will now exit on St. James Avenue. The most important changes are as follows:

- Previously, traffic headed east or west on Storrow Drive went straight up Berkeley Street northbound to the on-ramp just past Beacon Street. Since this traffic will now exit onto St. James Avenue, it must proceed to

Traffic Impact at Intersections

500 Boylston Street Project Better

Reduced 500 Boylston Street Project Better

Equal Impact

V/C and LOS for 500 Boylston Street Project

0.98E / 0.97E

V/C and LOS for Reduced 500 Boylston Street Project

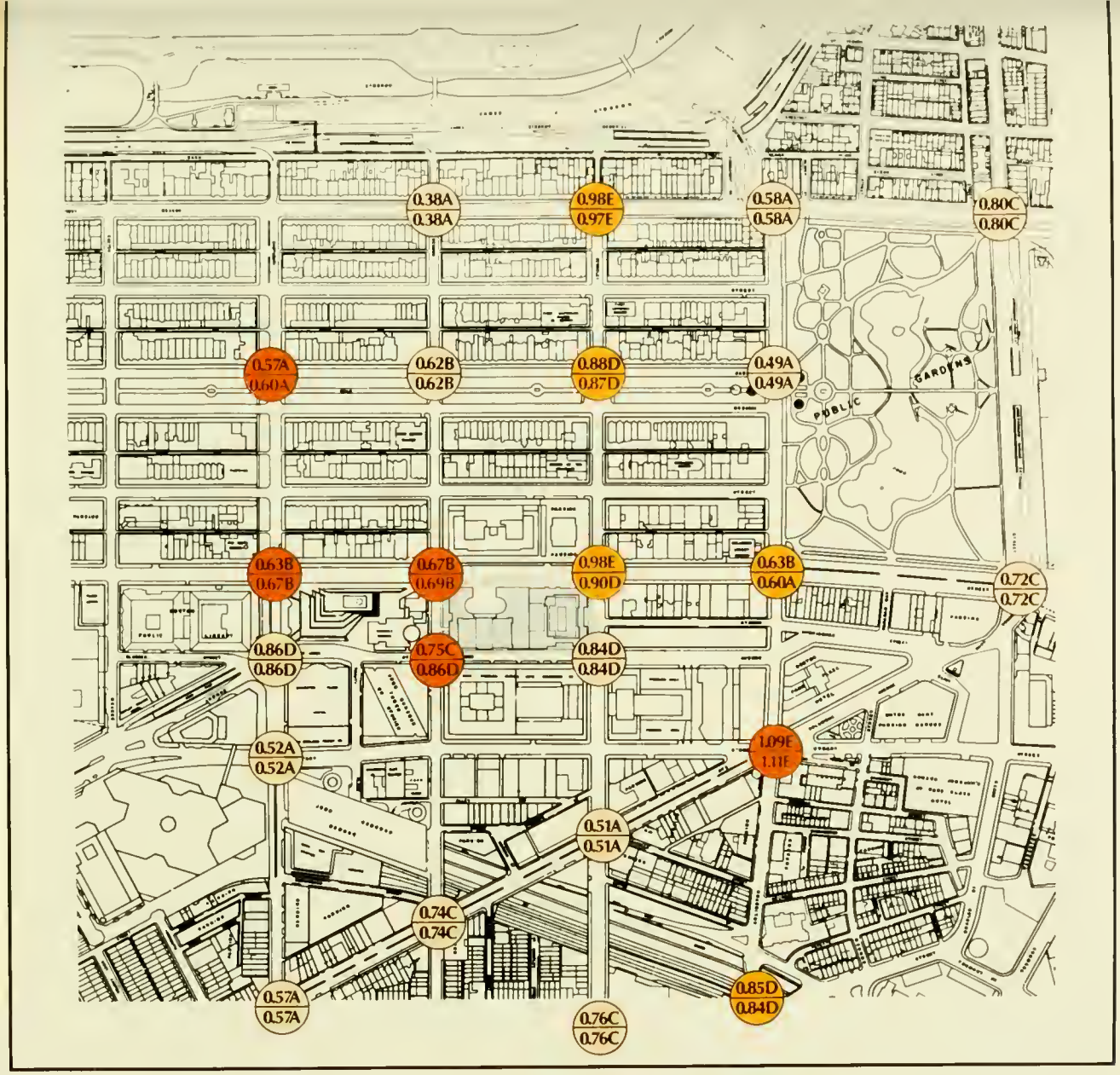

Fig. III-A-1

EASTERN COMPONENT · 500 BOYLSTON STREET · BOSTON, MASSACHUSETTS

The New England
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Dartmouth Street before turning north. Motorists headed eastbound on Storrow Drive will get to Berkeley Street via Commonwealth Avenue or Marlborough Street and enter Storrow Drive as they did before. Motorists headed westbound on Storrow Drive have two options. Some may decide to "backtrack" to Berkeley Street to enter Storrow Drive, while others may decide to turn west and go down Commonwealth Avenue or Beacon Street to enter Storrow Drive at Charlesgate. This is before any traffic diversion measures are implemented to reduce impacts on residential streets.

- The traffic which previously was routed up Berkeley Street and then west on Commonwealth Avenue or Beacon Street to Charlesgate will now follow the St. James Avenue/Dartmouth Street/Commonwealth Avenue or Beacon Street route.

- Traffic formerly headed eastbound on Boylston Street will now exit at St. James Avenue, turn left on Clarendon Street, then left again on Stuart Street. Those cars going south will turn right on Arlington Street, while those going further east will continue on Stuart Street or head back up to Boylston Street via Charles Street Extension, depending on their destination.

The result of these reroutings is a shift in volume from certain streets to others, generally in a favorable way. For example, there would be fewer cars on Berkeley Street, which has been cited by Back Bay residents as a concern in the past. This is shown by the improvement in level of service at the Boylston/Berkeley intersection from "E" to "D". The bulk of this traffic would shift over to St. James Avenue and Dartmouth Street, as shown by the change in level of service from "C" to "D" at

St. James/Clarendon. However, these streets are more commercially-oriented and the increased traffic should not be of as much concern to the Back Bay community. There would be some traffic shifts over to Commonwealth Avenue and Beacon Street, but these are estimated to be relatively small. Most of the changes resulting at all other locations evaluated are very small and would not be perceptible to the average motorist.

Figures III-A-2 and III-A-3 summarize the above information for the 500 Boylston Street Project and the Reduced 500 Boylston Street Project, respectively. They show the traffic volume and route pattern exiting the project garage for the 1989 PM peak hour under both Build conditions. Also shown is the percentage of the total exiting flow which occurs on each portion of the street network as the traffic disperses to the regional highway system. The largest benefit to traffic flow would occur on Berkeley Street, with PM peak hour decreases ranging from 21 to 181 vehicles, depending on the specific location. Boylston Street would decrease by 20 to 75 vehicles, with smaller decreases occurring on various other streets. The highest volume increases would occur on St. James Avenue (85 to 139 cars), Dartmouth Street (up to 94 cars), and on Stuart Street (15 to 64 cars). Smaller increases would occur on several other streets.

Changes in volume which would occur on other important residential streets in the area are as follows:

- Beacon Street: eight-car decrease east of Dartmouth Street, four-car increase west of Dartmouth Street.

- Marlborough Street: twenty-six-car increase east of Dartmouth Street.

Traffic Dispersal 500 Boylston Street Project

- Routes Using Berkeley Street Exit
- Routes Using St. James Avenue Exit
- 4% 1989 PM Peak Hour Percentage of Trips from Project
- (22) Number of PM Peak Hour Trips from Project

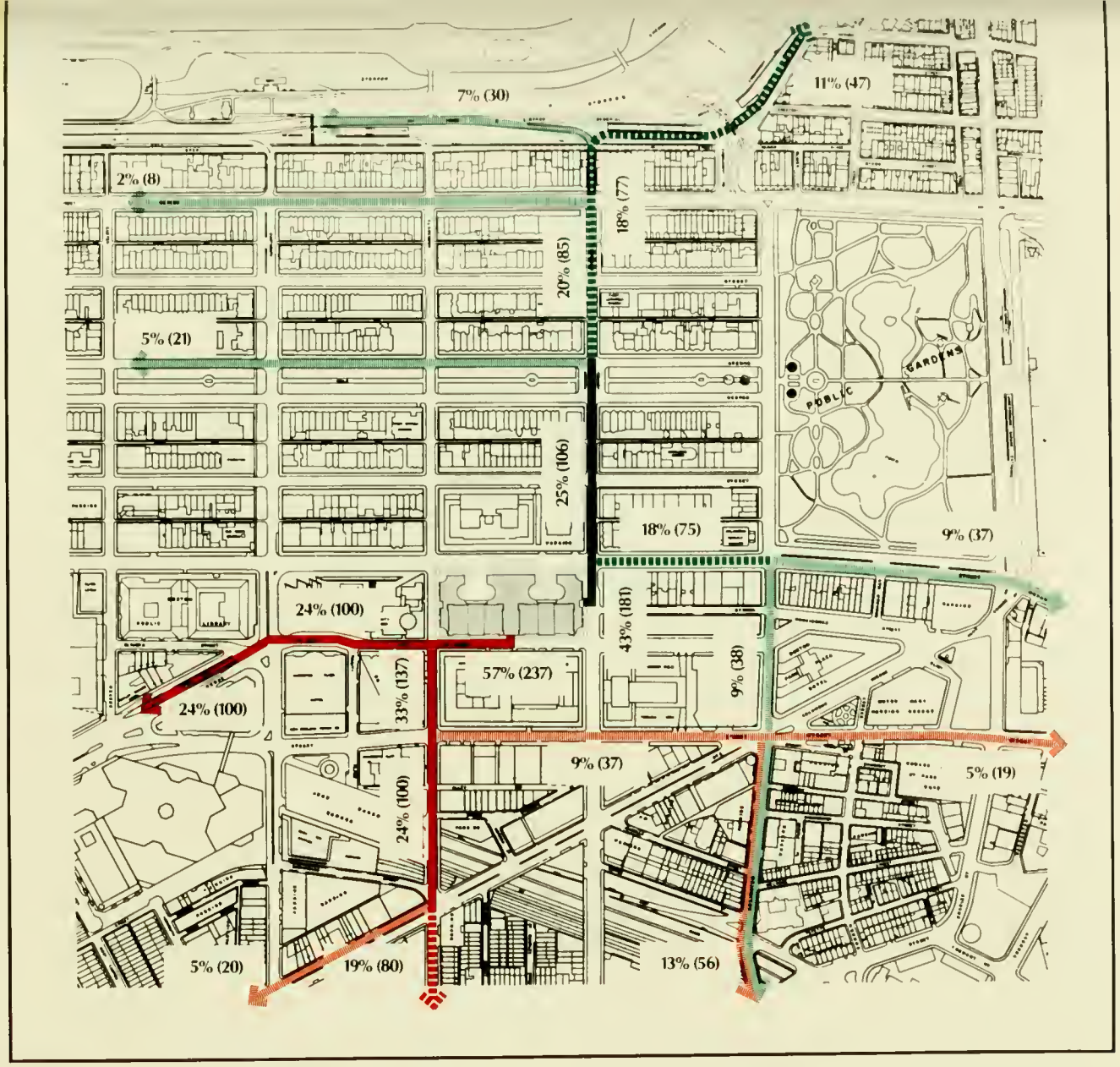

Fig. III-A-2

EASTERN COMPONENT · 500 BOYLSTON STREET · BOSTON, MASSACHUSETTS

The New England
Gerald D. Hines Interests

Robert A. M. Stern Architects • Design Architect
Jung Brannen Associates • Architects

Reduced 500 Boylston Street Project

Routes Using St. James Avenue Exit

4% 1989 PM Peak Hour Percentage of Trips from Project

(22) Number of PM Peak Hour Trips from Project

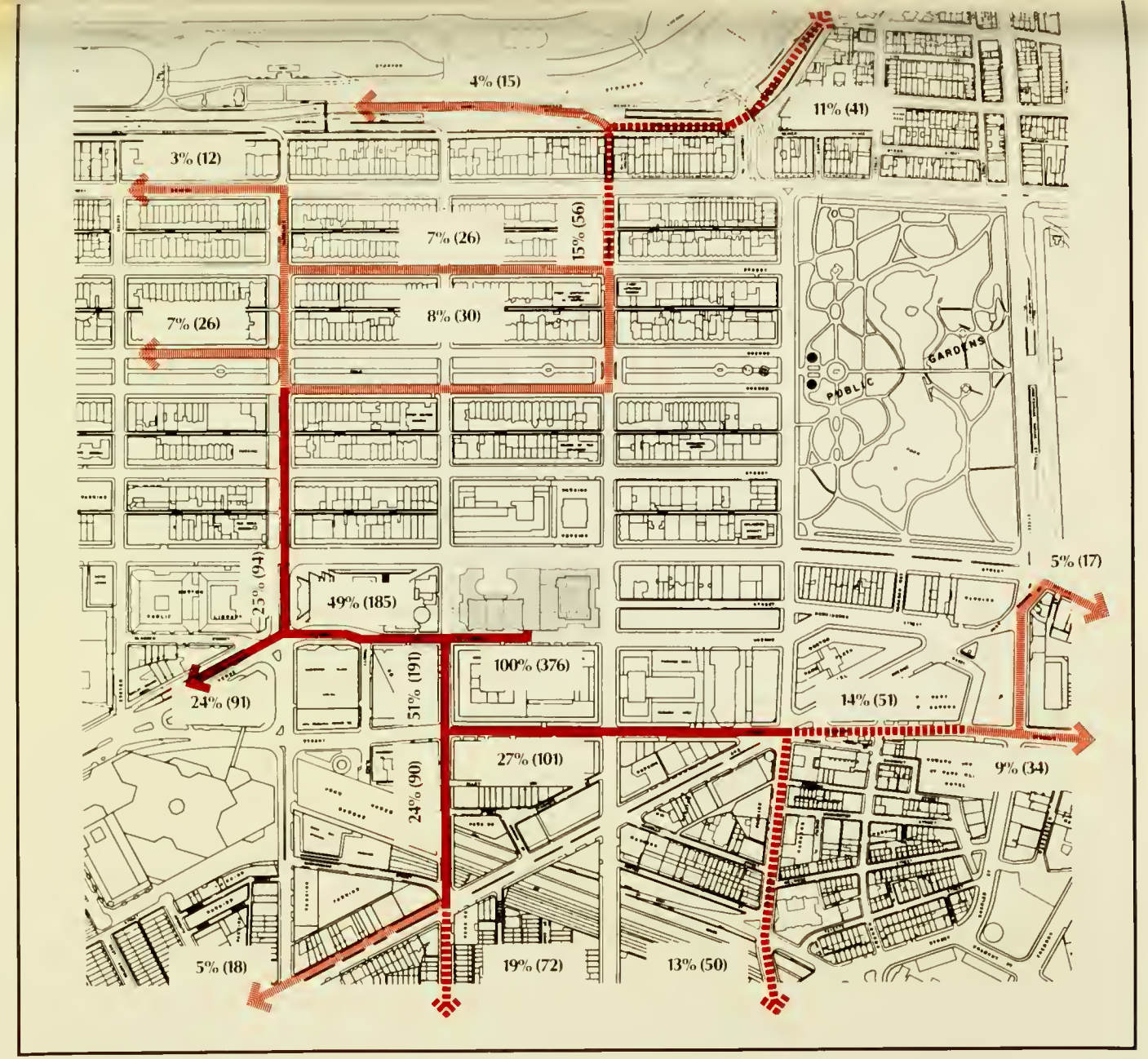

Fig. III-A-3

- Commonwealth Avenue: nine-car increase east of Dartmouth Street, five-car increase west of Dartmouth Street.

- Clarendon Street: no change north of St. James Avenue.

It should be noted that these changes represent a pre-mitigation condition. Measures to alleviate traffic increases on certain residential streets are presented in a subsequent section.

3. Traffic Analyses of Alternative Eastern Component Development Scenarios

During reassessment of the Reduced 500 Boylston Street Project, several alternative development scenarios were suggested as having the potential to reduce project impacts, specifically those relating to the Eastern Component portion of the development. Each of these is summarized in Table III-A-3 and compared to the Eastern Component of the Reduced 500 Boylston Street Project.

TABLE III-A-3
ALTERNATIVE EASTERN COMPONENT DEVELOPMENT SCENARIOS

Use	Reduced Project	Alternative Scenario 1	Alternative Scenario 2	Alternative Scenario 3
Office	452,400 SF	---	125,000 SF	37,000 SF
Retail	28,700 SF	37,000 SF	37,000 SF	37,000 SF
Hotel	---	475 Rooms	---	---
Condominiums	---	---	250 Units	325 Units

For each scenario, the designated uses have been substituted for the mostly-office scenario included in the BRA Draft EIR (DEIR) and analyzed to determine the difference in traffic impacts. This was done for the PM peak hour at seven selected intersections.

For each scenario, the trip generation estimates for the designated land uses were developed using trip rates from the BRA DEIR, the Copley Place EIR (for the hotel), or from published rates available from the Institute of Transportation Engineers (for condominiums). The condominium rates were reduced by 25 percent to account for transit use. This is conservative in that the actual transit use will probably be much higher.

Trip distributions were obtained from the DEIR for office and retail uses and from the Copley Place EIR for the hotel. The distribution pattern used for condominium trips was the same as that used for office/retail trips.

These Eastern Component vehicle-trip assignments were then added to the 1989 No-Build and Western Component project assignments to obtain revised total 1989 Build estimates. These were then analyzed for their traffic impacts in terms of volume-to-capacity (V/C) ratio and level of service at the designated intersections.

Table III-A-4 summarizes the analysis results for the three alternative Eastern Component scenarios (three right columns) but also repeats the results for the other 1989 Build conditions included in Table III-A-2 as a comparison. At most of the locations, there is very little or no change from the previously-obtained results.

The largest changes are projected to occur at the two Dartmouth Street intersections, where decreases in V/C ratios of 0.05-0.06 and 0.04 would occur at Commonwealth Avenue and St. James Avenue, respectively, compared to the previously-analyzed scenarios which deleted the Berkeley Street Garage exit. This is due to the fact that Dartmouth Street is an exit route from the project. Under a mostly-office scenario, more impact

TABLE III-A-4
TRAFFIC ANALYSIS RESULTS FOR WEEKDAY PM PEAK HOUR
UNDER ALTERNATIVE EASTERN COMPONENT DEVELOPMENT SCENARIOS AT SELECTED INTERSECTIONS

Intersection	Reduced Project 1,200,000 SF Without Berkeley Street Garage Exit 1989 Build		Alternative Scenario 1* for Phase 2 1989 Build		Alternative Scenario 2** for Phase 2 1989 Build		Alternative Scenario 3*** for Phase 2 1989 Build	
	V/C	LOS	V/C	LOS	V/C	LOS	V/C	LOS
Beacon/Berkeley	0.9x	E	1.00	E	0.97	E	0.97	E
Beacon/Arlington	0.58	A	0.58	A	0.58	A	0.58	A
Commonwealth/Dartmouth	0.61	B	0.56	A	0.55	A	0.55	A
Commonwealth/Berkeley	0.86	D	0.87	D	0.85	D	0.85	D
Boylston/Berkeley	0.90	D	0.90	D	0.90	D	0.90	D
Boylston/Arlington	0.60	A	0.60	A	0.60	A	0.60	A
St. James/Dartmouth	0.86	D	0.82	D	0.82	D	0.82	D

* Hotel - 475 rooms; Retail - 37,000 SF; no garage exit on Berkeley Street.
** Office - 125,000 SF; Condominiums - 250 units; Retail - 37,000 SF; no garage exit on Berkeley Street.
*** Condominiums - 325 units; Retail - 37,000 SF; no garage exit on Berkeley Street.

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occurs in the PM peak hour than in the less office-intensive Scenarios 1, 2 and 3. However, a correspondingly higher PM traffic flow would occur inbound on Clarendon Street (which was not analyzed) to the hotel or condo units, offsetting the benefits on Dartmouth Street. Little if any change is projected along Berkeley Street, although it is interesting to note that under Scenario 1, a V/C of 1.00 results at Beacon/Berkeley, up 0.02-0.03 from previous scenarios without the Berkeley Street Garage exit. It should be noted that there is no difference in traffic operating results between Scenarios 2 and 3. This is due to the fact that the decreased office space of Scenario 3 is just about offset by more condo units in Scenario 2.

AM peak hour differences, although not analyzed, are projected to be even less than the PM results, similar to the analyses presented in the DEIR.

The following paragraphs document the reasons why the mostly residential Eastern Component scenarios show such small differences in traffic analysis results when compared with more office-intensive uses.

Vehicle-trip generation estimates for the 1989 PM peak hour when the Reduced 500 Boylston Street Project are completed are summarized in Table III-A-5 for the Reduced 500 Boylston Street Project and the three alternative development scenarios for the Eastern Component. The land use estimates are shown for each alternative (net new, i.e., proposed minus existing on-site), along with the vehicle-trip estimates. Since there is a sizeable office component in each case, this tends to control the magnitude of the total project's vehicular trip generation regardless of what is proposed in the Eastern Component. Even the least traffic-intensive option for the Eastern Component (Scenario 3, which is virtually all residential) results in a total project PM

TABLE III-A-5
VEHICLE-TRIP GENERATION (REDUCED 500 BOYLSTON STREET PROJECT) FOR
ALTERNATIVE DEVELOPMENT SCENARIOS

Development Scenario	Net New Space* (and PM Peak Hour Auto Trips)				Total PM Peak Hour Auto Trips
	Office	Hotel	Condos	Retail	
Reduced Project	862,000 SF (538)	--	--	34,000 SF (24)	(562)
Alternative Phase 2 Scenario 1	410,000 SF (256)	475 rooms (258)	--	34,000 SF (24)	(538) 96% of Reduced Project
Alternative Phase 2 Scenario 2	535,000 SF (334)	--	250 units (96)	34,000 SF (24)	(454) 81% of Reduced Project
Alternative Phase 2 Scenario 3	410,000 SF (256)	--	325 units (125)	34,000 SF (24)	(405) 72% of Reduced Project

* Proposed minus existing on-site.

0875/987/wpr-EQ7

peak hour vehicle-trip estimate which is only 157 trips less than the Reduced 500 Boylston Street Project (405 trips for Scenario 3 versus 562 for the Reduced 500 Boylston Street Project). Scenario 3 still represents about three-quarters of the total trips generated by the Reduced 500 Boylston Street Project.

The 157 fewer trips generated by the mostly-residential Scenario 3, when distributed among the various alternative access routes to and from the project site, result in relatively few trips at each analysis location. When combined with the fact that total estimated 1989 No-Build (without 500 Boylston Street but with all other proposed projects) traffic volumes entering each analysis intersection are on the order of 2,000 to 3,000 cars or more, it can be seen that the impact of these different land use scenarios on any single intersection is small. This was demonstrated in Table III-A-4. There are some benefits to be gained by implementing the less traffic-intensive Eastern Component scenarios, depending on the location, but these benefits tend to be very small. Also, as stated previously, some locations not analyzed in Table III-A-4, notably those along Clarendon Street, would most likely show some adverse impact from the hotel or condo scenarios during the PM peak hour since inbound traffic to the project would be more prevalent for these land uses than for office space, and inbound project traffic would use Clarendon Street.

These results indicate that, no matter how the total project is configured, there is little real difference in traffic operation on Back Bay intersections, and that the impacts can be lessened through the measures described in the BRA DEIR.

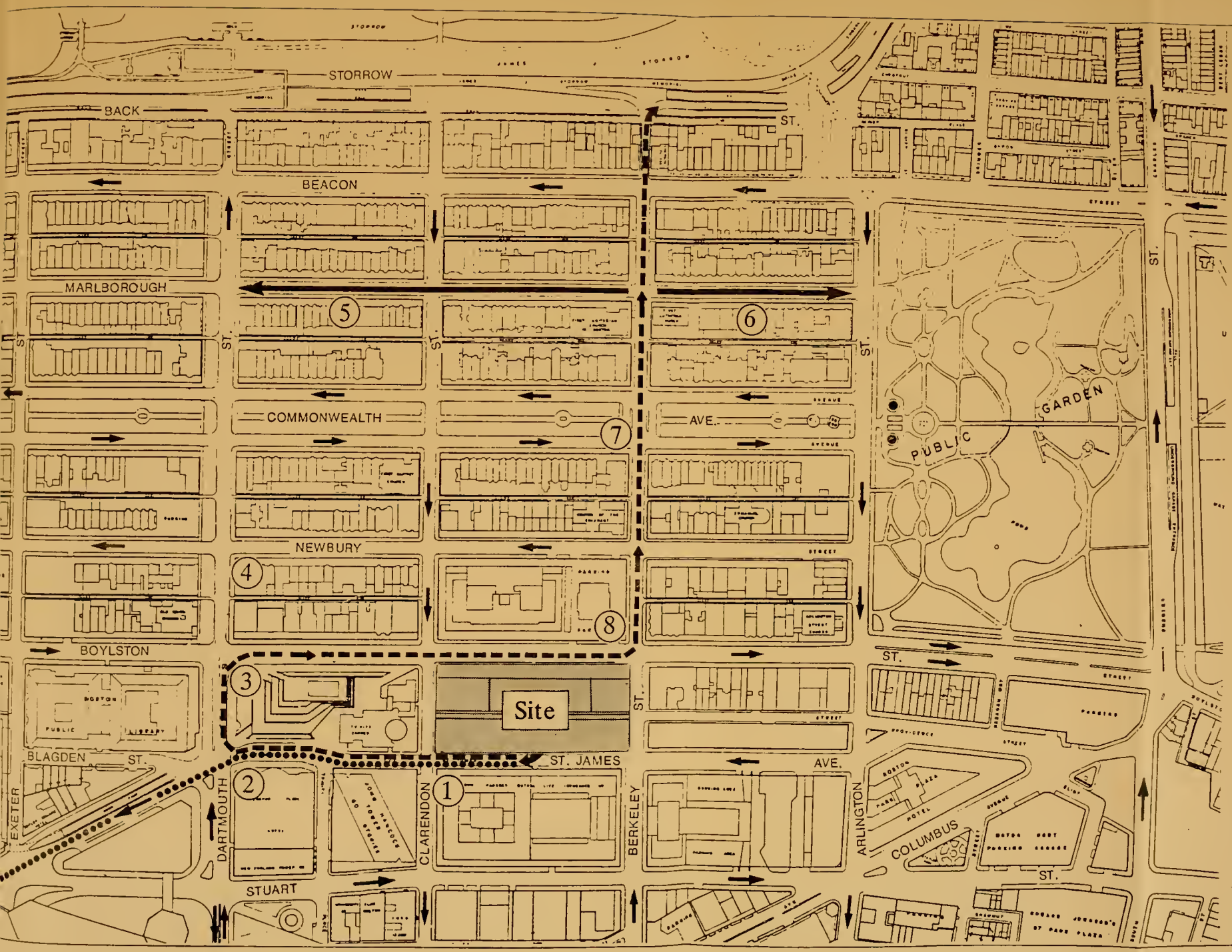
4. Traffic Diversion Measures

During the period when the above-described analyses were being conducted, several meetings were held with representatives of the Back Bay community to discuss the results. As a result of continuing concerns about general traffic flow patterns through the neighborhood, as well as the Eastern Component's potential for adding new trips to certain residential streets due to elimination of the Berkeley Street Garage exit, a short-term traffic diversion program was prepared to respond to these concerns. These measures are proposed in addition to the mitigation measures included in the BRA EIR. The program is shown in Figure III-A-4 and discussed below.

The objectives of these measures are to: (a) address the specific concerns expressed about traffic on Marlborough Street and Commonwealth Avenue by the Back Bay representatives (their preference is to redirect this traffic to Boylston and Berkeley Streets, and (b) encourage alternative traffic routes to Storrow Drive and the Massachusetts Turnpike which avoid, to the extent possible, neighborhood streets. Therefore, the proposed measures include the following (the item numbers are keyed to Figure III-A-4):

1) Signing on St. James Avenue at Clarendon Street which directs traffic destined for Storrow Drive westbound to proceed straight, and for westbound Turnpike traffic to proceed straight (to the Huntington Avenue entrance ramp) or turn left onto Clarendon Street (to the entrance ramp under the Hancock Garage).

2) Signing on St. James Avenue at Dartmouth Street which directs Storrow Drive westbound traffic to proceed straight via Huntington Avenue and for Storrow Drive



Potential Short-Term Diversion Measures

LEGEND:

- Project Trips to Storrow Dr. EB
- Project Trips to Storrow Dr. WB

1. Signing on St. James Ave.: ↑ Storrow Dr. WB; ← Mass Tpke. WB
2. Signing on St. James Ave.: Storrow Dr. WB ↑; Storrow Dr. EB →
3. Signing on Dartmouth St. Storrow Dr. EB →
   Retime Signal to Encourage Right Turn to Boylston St.
4. Signing on Dartmouth St. ← Mass Tpke. WB
5. Make Marlborough St. 1-Way from Berkeley St. to Dartmouth St.
6. Make Marlborough St. 1-Way from Berkeley St. to Arlington St.
7. Install No Left Turn Sign from Commonwealth Ave. to Berkeley St. (4-6P.M.) Station Traffic Control Supervisor During P.M. Peak.
8. Restripe Boylston St. EB Approach:
   Install Exclusive Pedestrian Phase. Station Traffic Control Supervisor During P.M. Peak.

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0 150 300
SCALE IN FEET

Fig. III-A-4

eastbound traffic to turn right onto Dartmouth Street. Additional signing to Storrow Drive westbound should be added at key locations along the route via Huntington Avenue, Belvidere Street, Dalton Street and Boylston Street. Signing for the Turnpike at the St. James Avenue/Dartmouth Street intersection is not required since the signed entrance ramp is just beyond the intersection on Huntington Avenue.

3) Signing on Dartmouth Street at Boylston Street to direct traffic destined for Storrow Drive eastbound to turn right onto Boylston Street. Consideration should also be given to retiming the signal at this location to encourage this right turn and discourage through traffic north on Dartmouth Street.

4) Signing on Dartmouth Street at Newbury Street to the Turnpike westbound.

5) Reversal of the existing traffic direction on Marlborough Street between Berkeley and Dartmouth Streets to prevent bypass traffic currently using residential Marlborough Street from reaching Berkeley Street. This two-block section would become westbound. Modifications to traffic signal heads and signs would be required.

6) Reversal of the existing traffic direction on Marlborough Street between Arlington Street and Berkeley Street. This one-block section would become eastbound, as it used to be. This measure would prevent use of Marlborough Street as a westerly bypass route for certain trips on Beacon Street, after Item 5 above is implemented.

7) Restriction of the left turn from Commonwealth Avenue to Berkeley Street during the 4:00 to 6:00 PM peak period to prevent bypass traffic currently using residential Commonwealth Avenue from reaching Berkeley Street. This will require strict enforcement. It is recommended, therefore, that a City traffic control supervisor be stationed here in the PM peak period.

8) Striping the eastbound Boylston Street approach at Boylston/Berkeley to provide an exclusive left-turn lane, a shared through/left-turn lane, and an exclusive through lane. This is designed to increase the left-turn capacity to accommodate traffic diverted from Marlborough Street and Commonwealth Avenue. An exclusive pedestrian phase should also be considered to reduce vehicle/pedestrian conflicts. A traffic control supervisor should also be stationed at this location to aid in reducing congestion during the PM peak period.

Figure III-A-5 summarizes the estimated impacts of implementing these traffic diversion measures. Compared to impacts shown in Figure III-A-1, V/C ratios increase along sections of Boylston and Berkeley Streets, but remain under intersection capacity. V/C ratios decrease along Commonwealth Avenue, Dartmouth Street, and upper Berkeley street. Although not shown in Figure III-A-5, traffic would also decrease along Marlborough Street. Additional benefits would be gained by implementing the program of mitigation measures recommended in the BRA EIR.

These measures can provide short-term relief to the Back Bay community through relatively simple and inexpensive modifications. Also, they are easily reversible in the event that circumstances warrant such action. However, it is believed that these measures should be viewed as at least interim treatments

Traffic Impacts of Diversion

500 Boylston Street Project Better

Reduced 500 Boylston Street Project Better

Equal Impact

V/C and LOS for 500 Boylston Street Project

0.98E / 0.97E

V/C and LOS for Reduced 500 Boylston Street Project

Fig. III-A-5

which can lead into more permanent and effective alternatives for the area which are to be evaluated as part of the pending Back Bay Transportation Study which will be conducted by the Boston Transportation Department. The project proponents have continued to work with area representatives in identifying and evaluating various potential long-term solutions throughout the project's Eastern Component redesign. They have also participated with the BTD and others in assisting the scoping effort for the Back Bay Transportation Study and are prepared to continue their spirit of cooperation with all participants to insure that the transportation needs of Back Bay residents, employees and businesses are met in a satisfactory way.

B. SHADOW

1. Introduction

A series of computer-generated shadow analyses have been performed comparing the Reduced 500 Boylston Street Project with the 500 Boylston Street Project to predict and evaluate the extent of new project-generated shadows. The study area includes the area bounded by Beacon, Arlington, Stuart and Exeter Streets. Particular attention was paid to shadow casts on the following public spaces: pedestrian areas on Boylston, Newbury and Berkeley Streets; the Clarendon Street Playground; and Copley Square.

The analysis involved overlaying the 500 Boylston Street shadow studies with the Reduced 500 Boylston Street Project shadow studies to identify the differences between the shadows cast by the two buildings. Two areas of interest are delineated on the shadow studies (see Figures III-B-1 to III-B-9): (1) areas which are not in shadow under the Reduced 500 Boylston Street Project but which would have been in shadow with the development of the 500 Boylston Street Project; (2) areas of additional shadow cast by the Reduced 500 Boylston Street Project beyond that which was cast by the 500 Boylston Street Project.

The shadow analysis indicates that the Reduced 500 Boylston Street Project results in a large decrease, or removal of shadow cast by the 500 Boylston Street Project and a small increase in shadow (as compared to shadow cast by the 500 Boylston Street Project).

2. Probable Project Impacts

• March 21, Vernal Equinox

Decreased Shadow.

-- 9:00 AM - The Reduced 500 Boylston Street Project removes shadow (cast by the 500 Boylston Street Project) in front of the New England Life Building.

-- Noon - The Reduced Project removes shadow (cast by the 500 Boylston Street Project) on the sidewalk in front of the parking lot across from the Project site and at the intersection of Boylston and Berkeley Streets.

-- 3:00 PM - The Reduced Project removes shadow (cast by the 500 Boylston Street Project) on the alley between Boylston and Stuart Streets.

Additional Shadow.

-- 9:00 AM - The Reduced 500 Boylston Street Project casts a small amount of new shadow on the northern sidewalk of Boylston Street.

-- Noon - The Reduced Project casts a small amount of new shadow on the northern sidewalk of Boylston Street.

-- 3:00 PM - The Reduced Project casts a small amount of new shadow on Boylston Street between Berkeley and Arlington Streets.

- June 21, Summer Solstice

Decreased Shadow.

-- 9:00 AM - The Reduced Project removes a small area of shadow (cast by the 500 Boylston Street Project) on Boylston Street in front of the project site.

-- Noon - There is no decrease in project-related shadow at this time.

-- 3:00 PM - The Reduced Project removes shadow (case by the 500 Boylston Street Project) on Berkeley Street and the adjacent alley.

Additional Shadow.

-- 9:00 AM - The Reduced 500 Boylston Street Project casts a small amount of new shadow on Boylston Street in front of the project site.

-- Noon - The Reduced Project casts new shadow on the sidewalk and street in front of the project site.

-- 3:00 PM - The Reduced 500 Boylston Street Project casts shadow on the sidewalk in front of the project site on Berkeley Street and the Berkeley Street sidewalk.

- December 21, Winter Equinox

Decreased Shadow

-- 9:00 AM - The Reduced 500 Boylston Street Project removes shadow (cast by the 500 Boylston Street Project) on Newbury Street, Commonwealth Avenue and Marlborough Street.

-- Noon - The Reduced 500 Boylston Street Project removes shadow (cast by the 500 Boylston Street Project) on Newbury and Berkeley Streets.

-- 3:00 PM - The Reduced 500 Boylston Street Project removes shadow cast on Arlington Street, Boylston Street and the Public Garden.

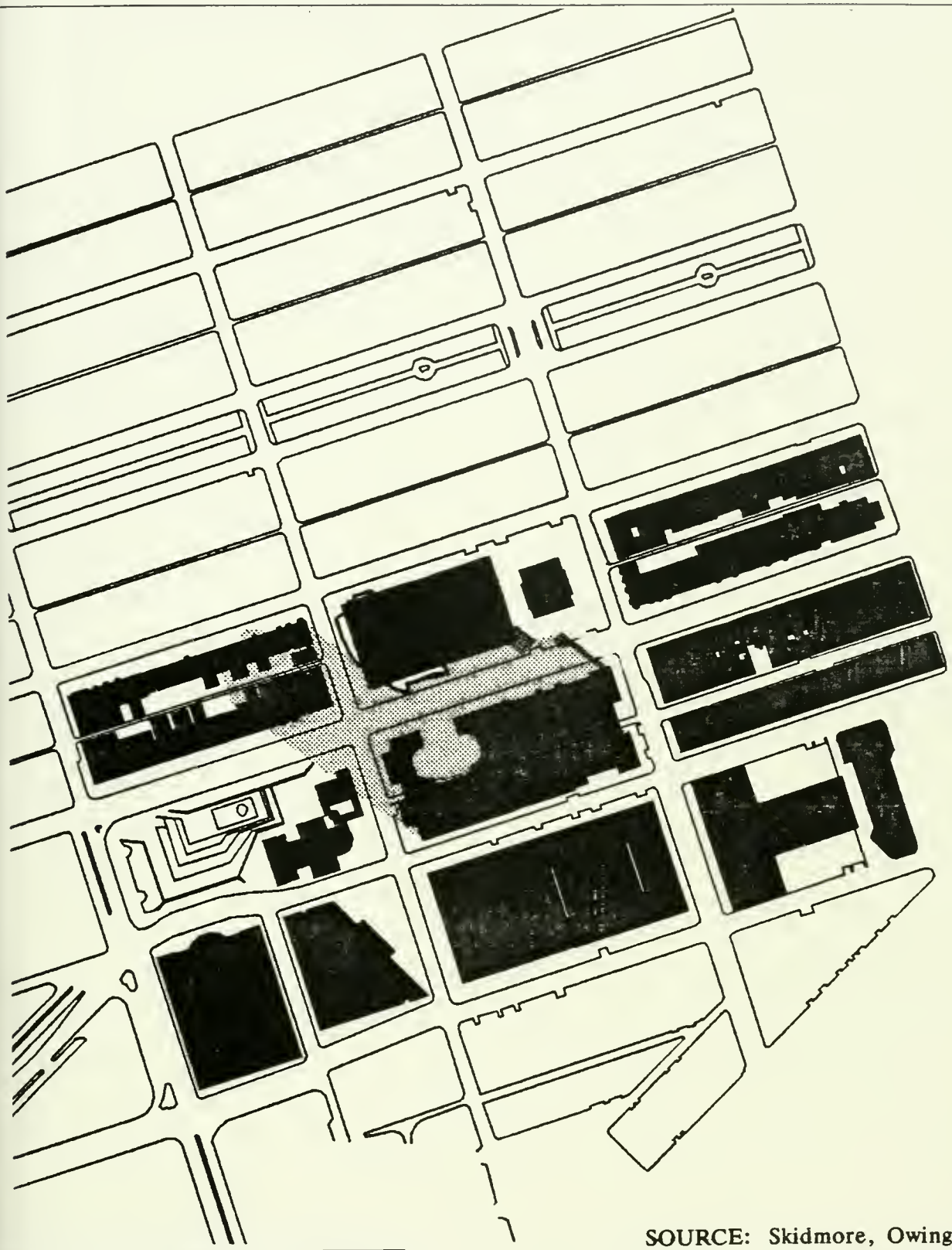
Additional Shadow.

-- There is a small area of additional shadow cast by the Reduced 500 Boylston Street Project on Boylston Street and Commonwealth Avenue in the morning. There is no additional shadow cast in the late morning or afternoon.

3. Conclusions

The shadow analysis indicates that the development of the Reduced 500 Boylston Street Project results in only small amounts of additional shadow when compared to the shadow cast by the 500 Boylston Street Project, and the removal of large areas of shadow by comparison to the 500 Boylston Street Project.

The Boylston Street pedestrian and retail area and Copley Square will not experience greater shadow coverage during any part of the day or year then they did with the 500 Boylston Street Project. The open space adjacent to the northern sidewalk on Boylston Street will experience slightly more shadow at Noon during March and September. The Commonwealth Mall and the Clarendon Street Playground at the corner of Clarendon Street and Commonwealth Avenue will not experience different shadow coverage then that caused by the 500 Boylston Street Project. Boylston Street will experience slightly more shadow during the summer in the morning and early afternoon. Except for the elimination of shadow cast by the 500 Boylston Street Project, the Reduced 500 Boylston Street Project and the 500 Boylston Street Project cast similar winter shadows.



SOURCE: Skidmore, Owings & Merrill

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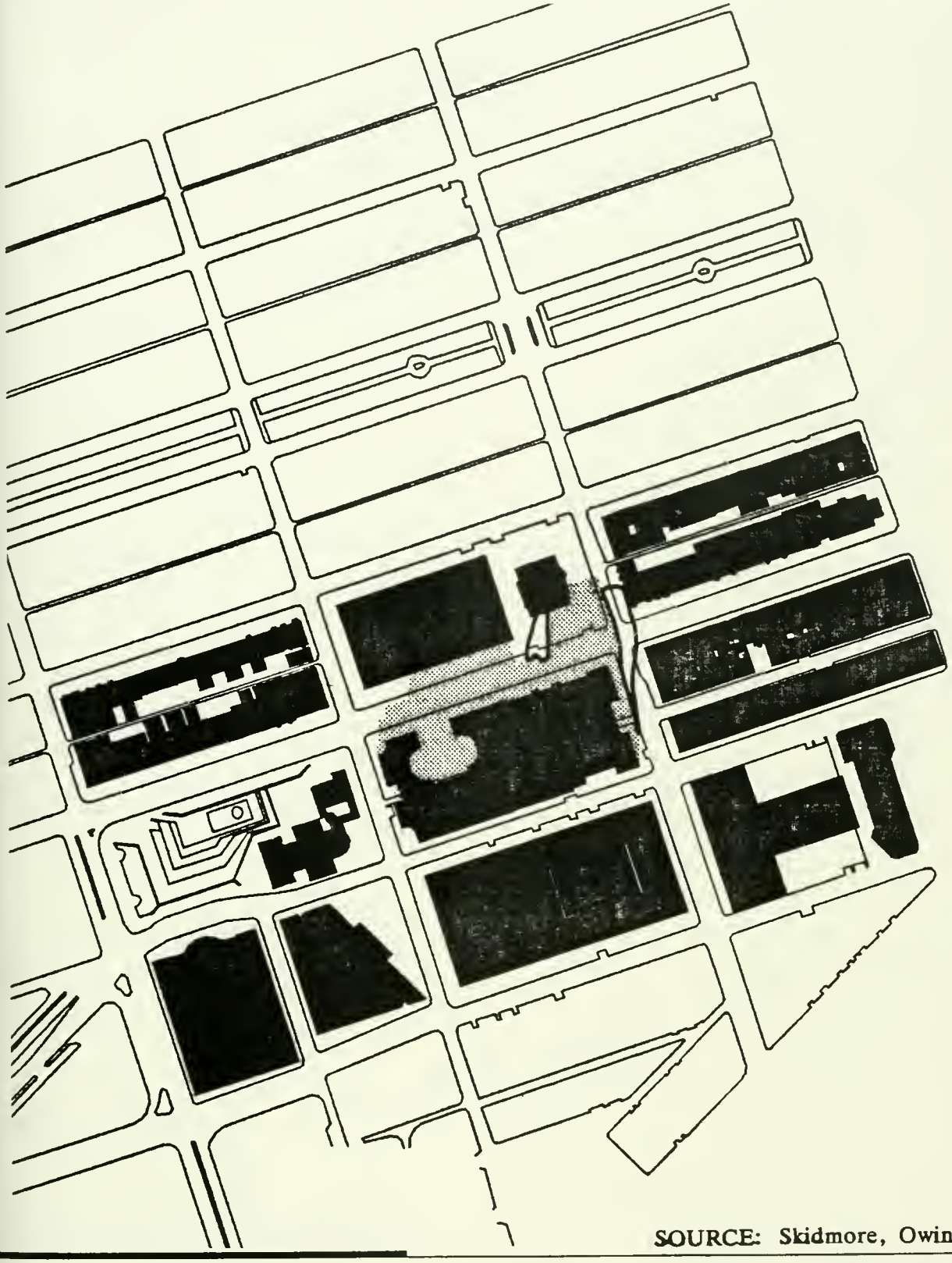
Shadow Conditions March 21 9:00 A.M.

LEGEND:

- Project Shadow
- Decreased Shadow
- Additional Shadow

0 150 300
SCALE IN FEET

Fig.III-B-1



SOURCE: Skidmore, Owings & Merrill

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Shadow Conditions
March 21
Noon

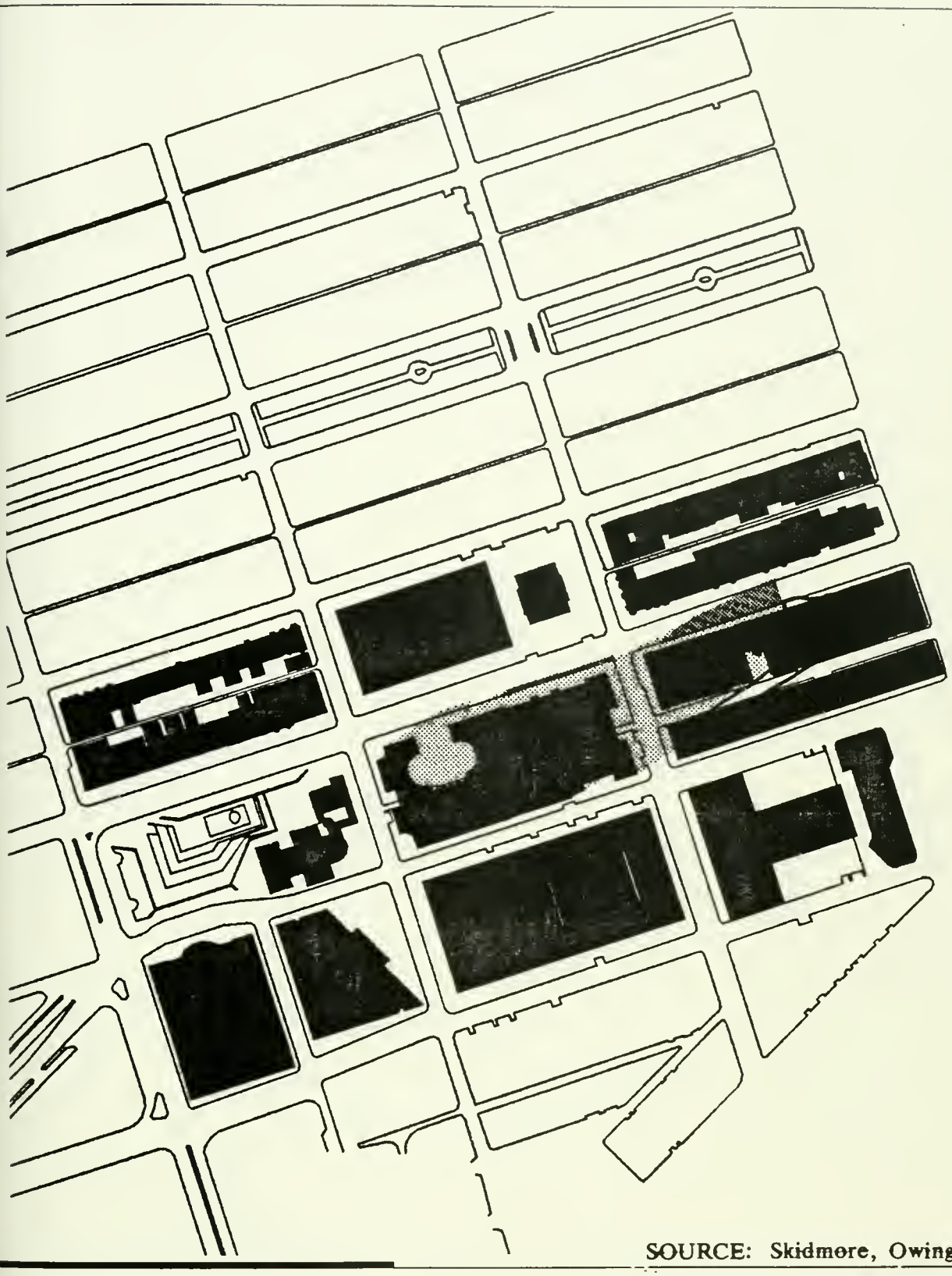
LEGEND:

Project Shadow

Decreased Shadow

0 150 300
SCALE IN FEET

Fig. III-B-2



SOURCE: Skidmore, Owings & Merrill

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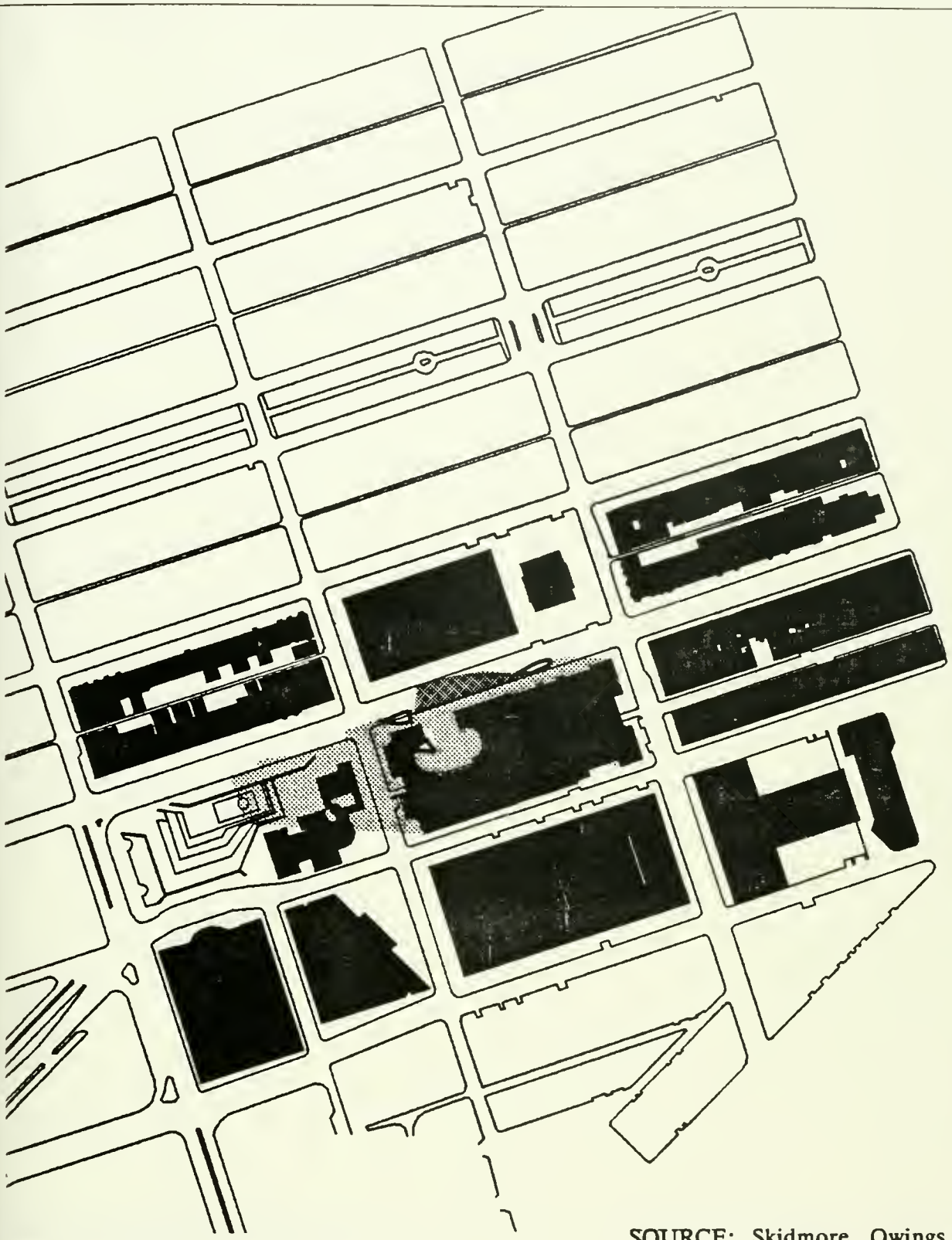
Shadow Conditions
March 21
3:00 P.M.

LEGEND:

- Project Shadow
- Decreased Shadow
- Additional Shadow

0 150 300
SCALE IN FEET

Fig. III-B-3



SOURCE: Skidmore, Owings & Merrill

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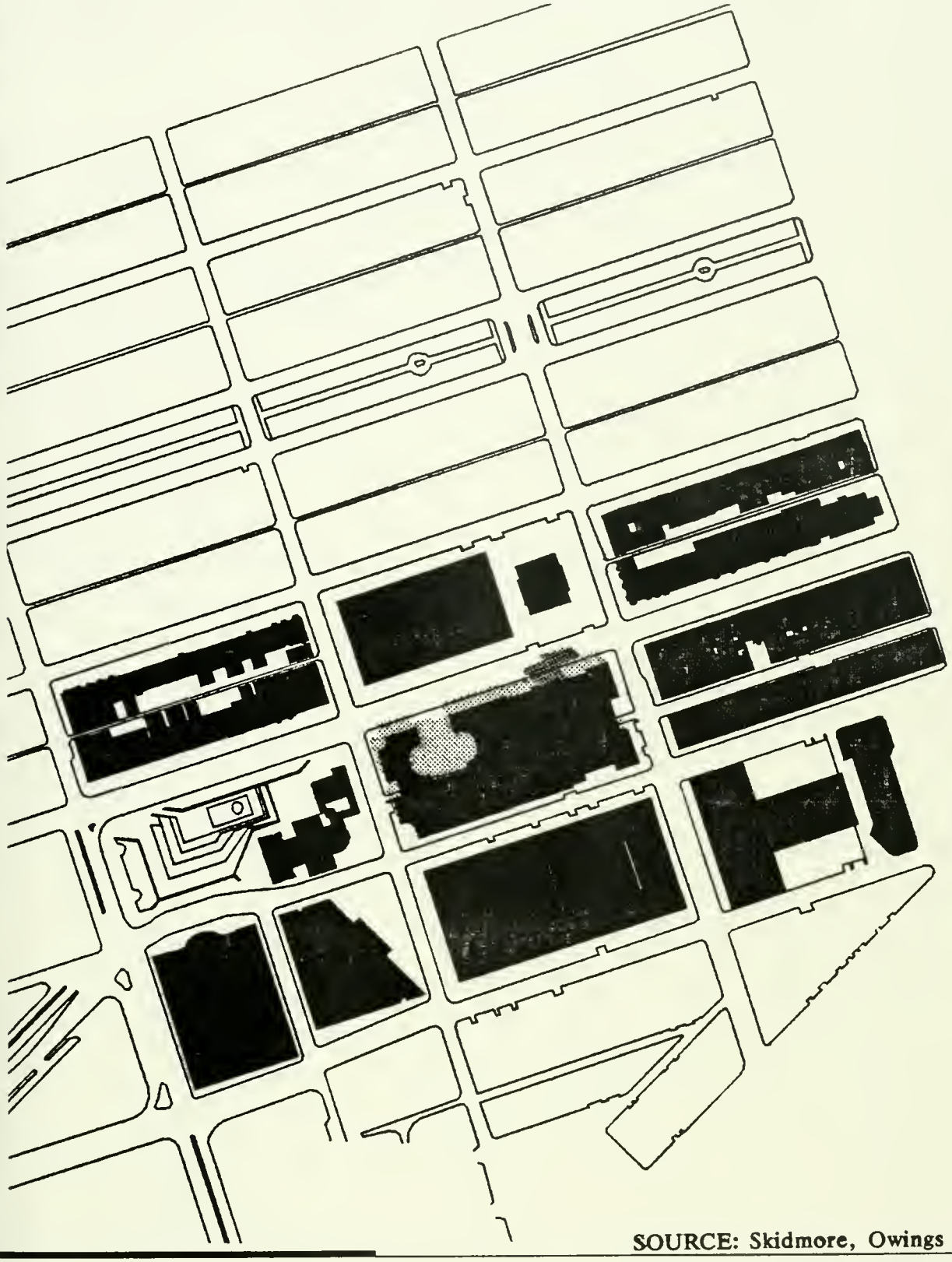
Shadow Conditions
June 21
9:00 A.M.

LEGEND:

- Project Shadow
- Decreased Shadow
- Additional Shadow

0 150 300
SCALE IN FEET

Fig. III-B-4



SOURCE: Skidmore, Owings & Merrill

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0 150 300
SCALE IN FEET

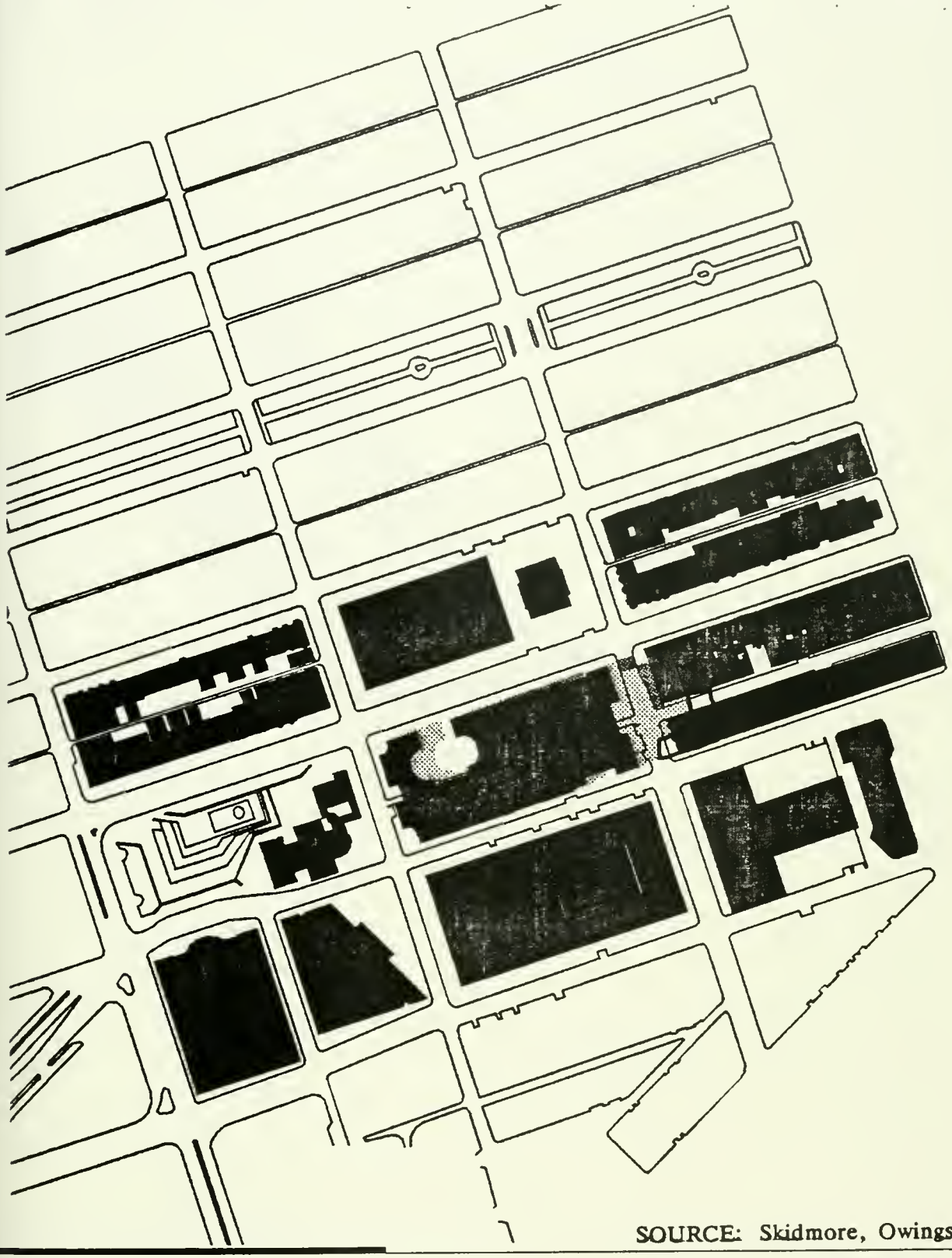
Shadow Conditions
June 21
Noon

LEGEND:

Project Shadow

Additional Shadow

Fig. III-B-5



SOURCE: Skidmore, Owings & Merrill

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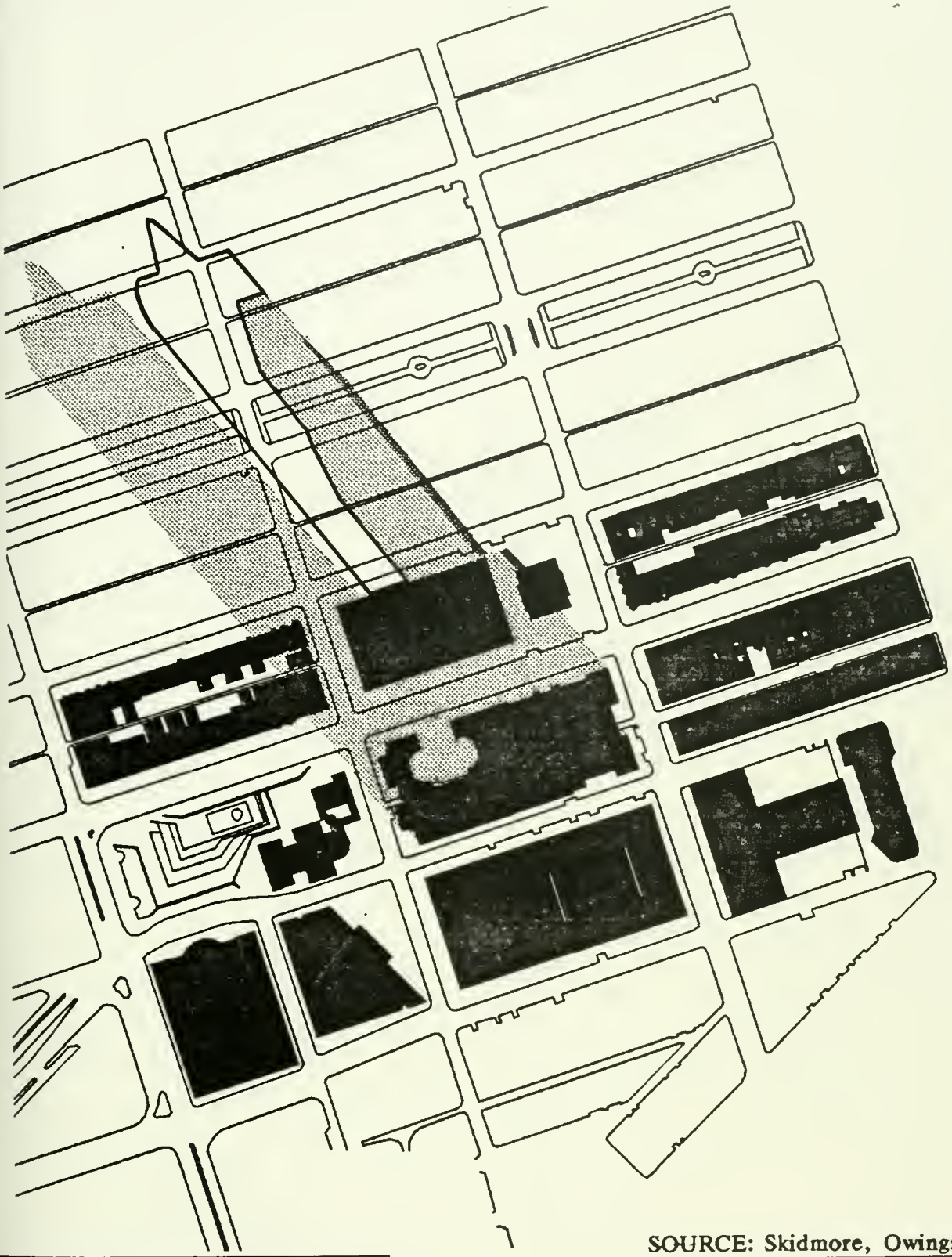
Shadow Conditions
June 21
3:00 P.M.

LEGEND:

- Project Shadow
- Decreased Shadow
- Additional Shadow

0 150 300
SCALE IN FEET

Fig.III-B-6



SOURCE: Skidmore, Owings & Merrill

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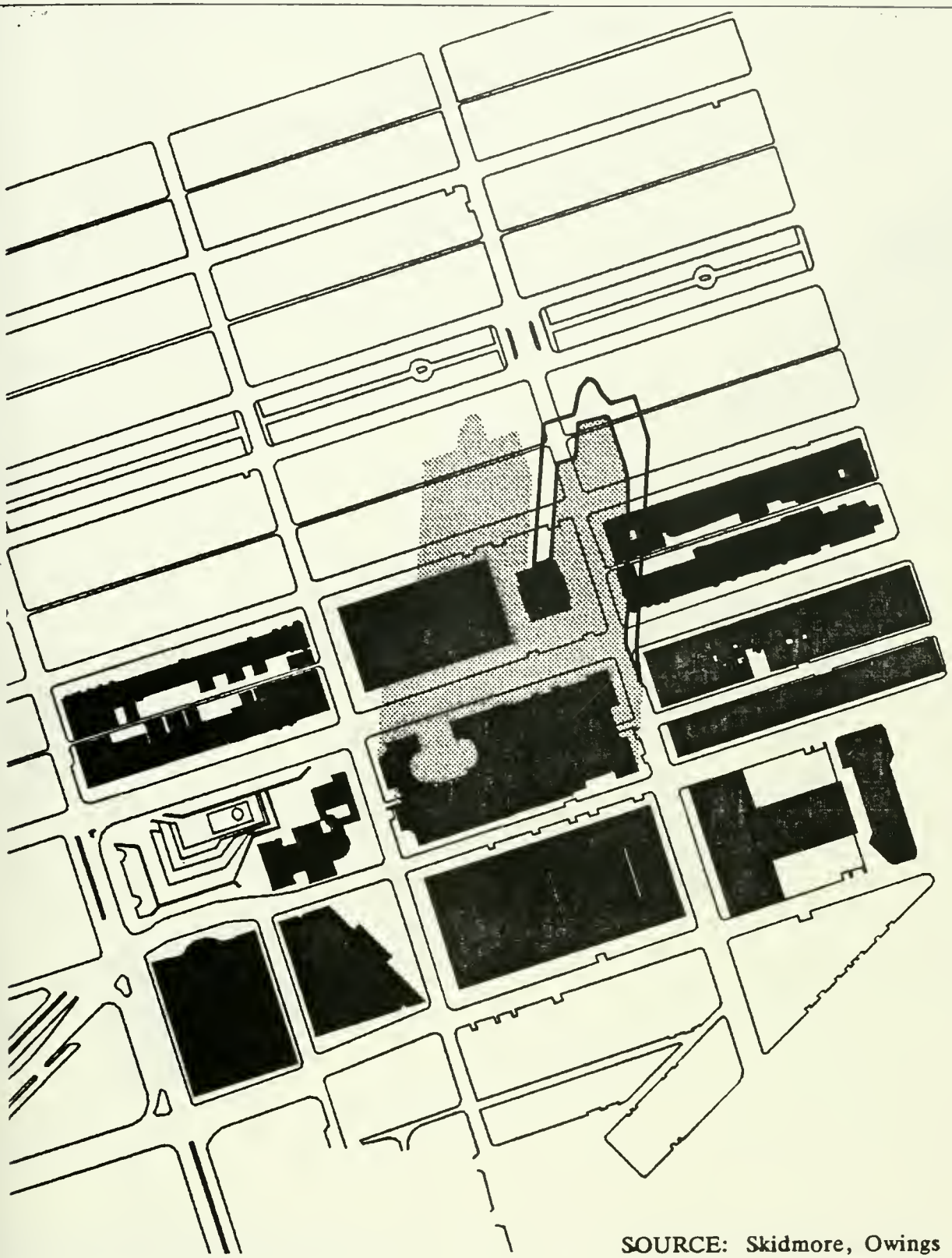
Shadow Conditions December 21 9:00 A.M.

LEGEND:

- Project Shadow
- Decreased Shadow
- Additional Shadow

0 150 300
SCALE IN FEET

Fig.III-B-7



SOURCE: Skidmore, Owings & Merrill

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Shadow Conditions December 21 Noon

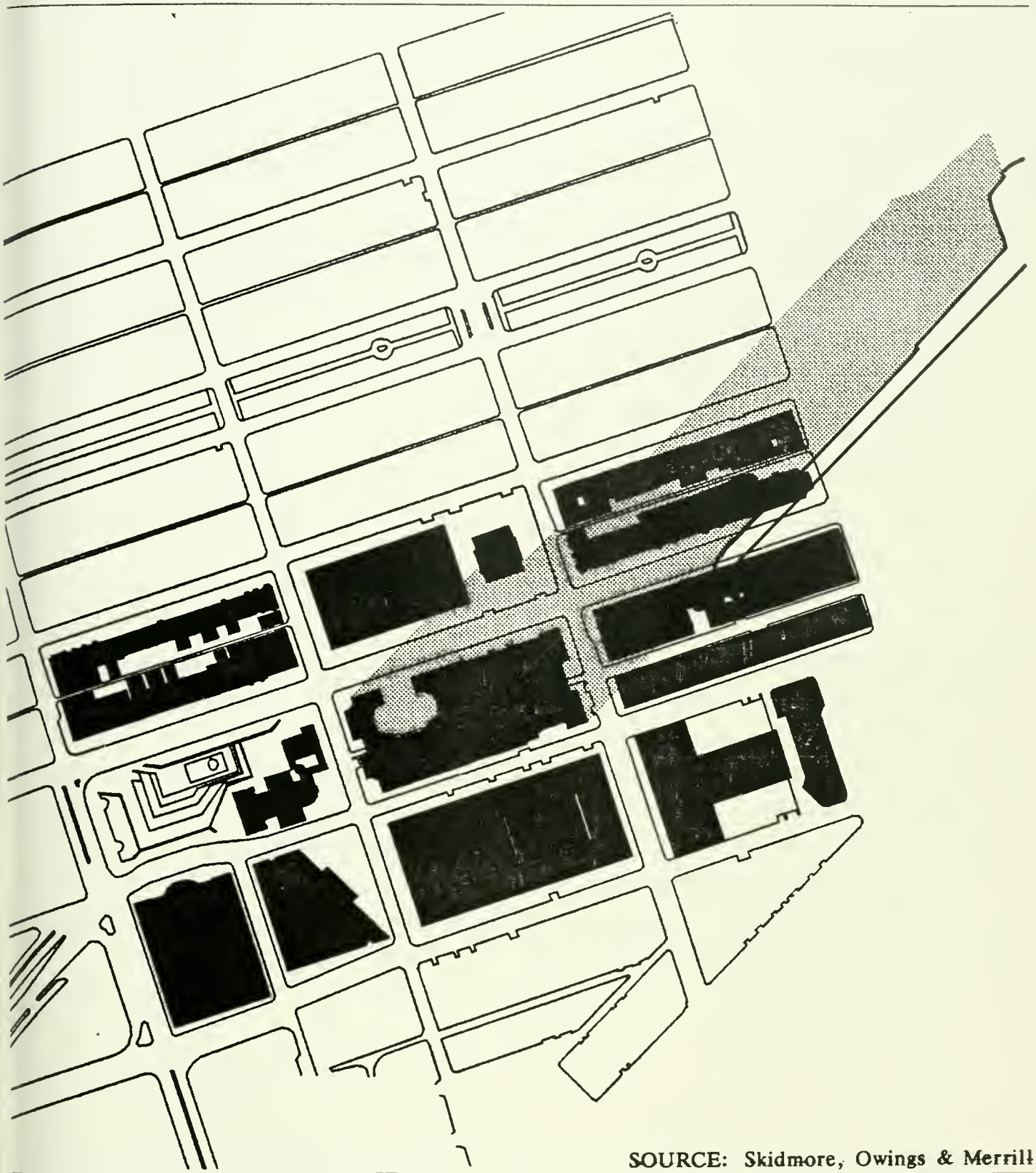
LEGEND:

Project Shadow

Decreased Shadow

0 150 300
SCALE IN FEET

Fig.III-B-8



SOURCE: Skidmore, Owings & Merrill

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Consulting Engineers & Planners
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Shadow Conditions December 21 3:00 P.M.

LEGEND:

Project Shadow

Decreased Shadow

0 150 300
SCALE IN FEET

Fig.III-B-9

C. WIND

1. Introduction

The Wright Brothers Memorial Wind Tunnel (WBWT) at the Massachusetts Institute of Technology has conducted wind tunnel tests, using the hot-wire technique, for the Reduced 500 Boylston Street Project. The hot-wire technique allows for the sensing of dynamic changes in wind velocity at predetermined stations on and near the project site. This quantitative method permits instantaneous recording of wind velocities as a function of time at specific pedestrian-level heights. Results of the hot-wire tests have been compiled and analyzed and are summarized below.

- Hot-Wire Tests

To study the pedestrian-level wind environment of the Reduced 500 Boylston Street Project, a 1:600 scale model encompassing the project site and the surrounding area within a 2,400-foot radius, was placed in the wind tunnel. The surrounding environment included the Tent City Project currently under construction and the proposed 116 Huntington Avenue Project. To accurately simulate wind conditions characteristic of densely built urban environments such as the areas surrounding the project site, spires and roughness blocks were also installed in the wind tunnel.

- Data Analysis

Pedestrian-level velocities were measured for winds from sixteen major compass directions at twenty-eight locations. Each station was monitored for the equivalent of one-hour full scale, and the outputs were screened so that only wind gusts of two-seconds (or longer) duration were recorded. Studies show that

gusts of shorter durations do not affect pedestrians. From the data, the average root mean square variation about the average velocity (rms) and peak two-second gust wind velocities were calculated.

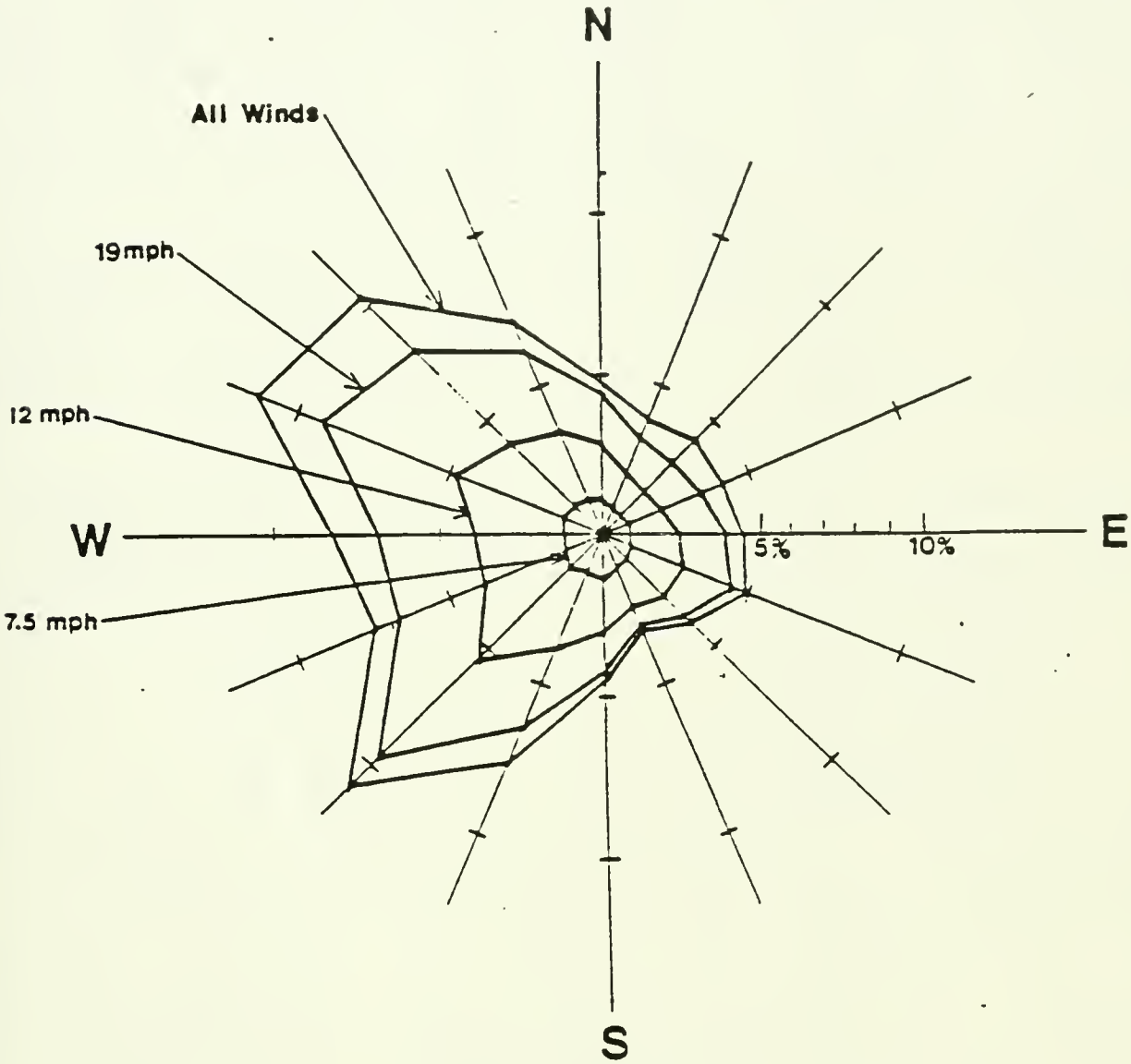
The average rms and peak gust velocities were weighted with a statistical description of the Boston wind climate to predict how often each of the three velocity types will occur at each station. The Boston wind climate was determined from wind roses (see Figure III-C-1) compiled from seasonal and annual wind velocity direction and magnitude data collected at Logan Airport for a 20-year period. The wind rose and wind tunnel data were combined to predict: 1) the hourly average velocity; 2) the effective gust velocity; and 3) the peak gust velocity during one hour every 100 hours at each station.

The three predicted velocities are used to calculate the equivalent average velocity. Because it uses the most critical of the three velocity types, the equivalent average method is a more conservative way of evaluating pedestrian-level winds than methods that only consider average or effective gust velocities.

Figure III-C-2 locates each of the twenty-eight stations tested under the Reduced 500 Boylston Street Alternative. Table III-C-1 presents the equivalent average velocities and Melbourne Category's calculated for each station.

- <u>Comfort Criteria</u>

In order to evaluate the pedestrian-level effects of wind velocities, the predicted equivalent average velocities obtained from the wind tunnel analyses were compared to comfort criteria.



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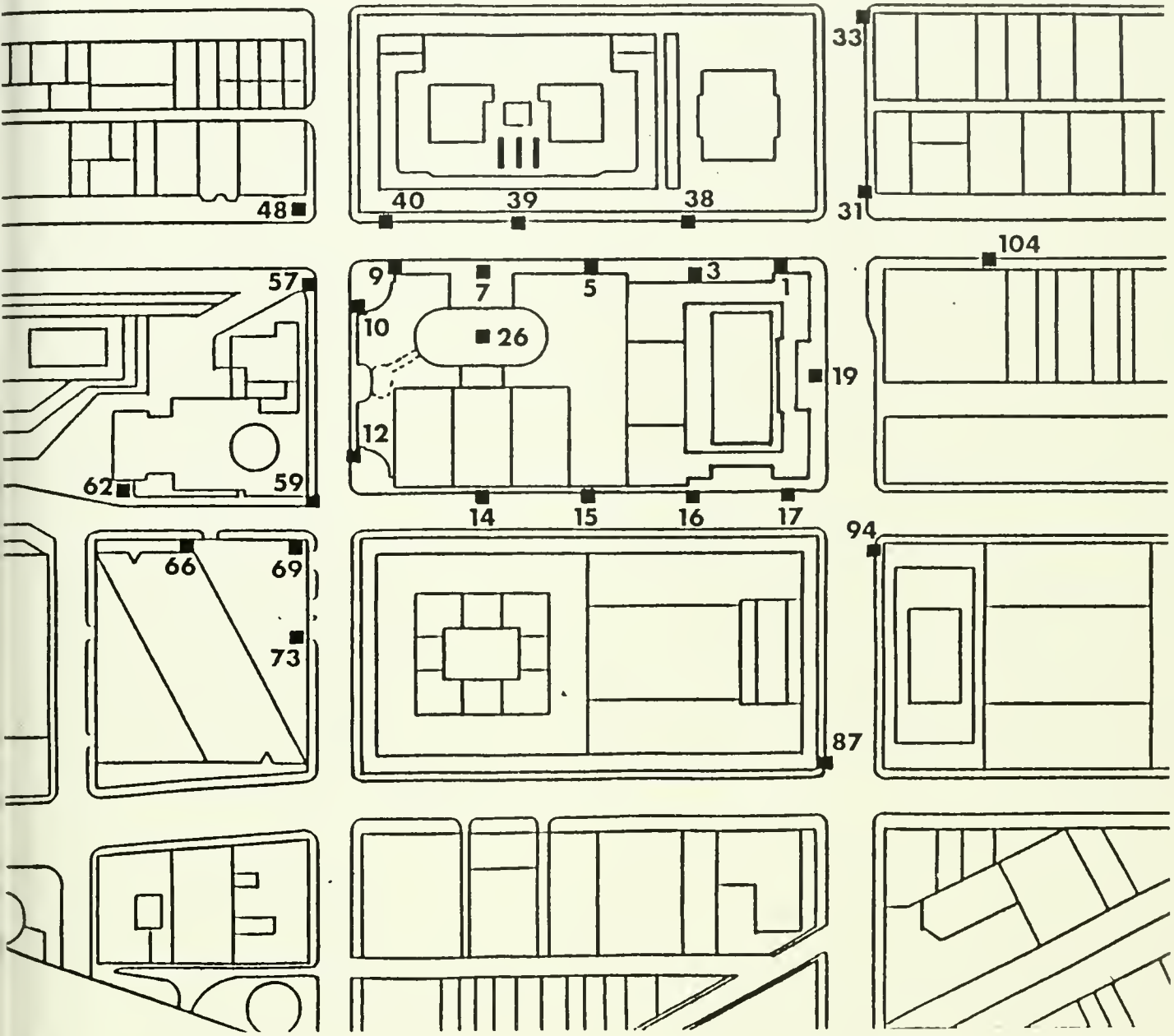
Wind Rose

Fig. III-C-1



SOURCE: WBWT

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0 200 400
SCALE IN FEET

Reduced 500 Bolyston St. Project Wind Station Locations

Fig. C-III-2

-- Melbourne Criteria

The set of criteria applied to the wind velocity data in this study was developed by W.H. Melbourne in 1978. Based upon a literature review of past studies and other wind comfort criteria, Melbourne developed a probabalistic criteria for hourly average pedestrian-level wind speeds defined by safety considerations and different types of human activity accommodated by each level of wind speed. Melbourne established five levels of human comfort criteria: Category 1, unacceptable and dangerous; Category 2, uncomfortable for walking; Category 3, comfortable for walking; Category 4, comfortable for short periods of standing; and Category 5, comfortable for long periods of standing or sitting. Melbourne's categories can be used to assign to each criteria level, a characteristic range of hourly average pedestrian-level wind speeds with a one percent probability of occurrence as shown in Table III-C-2. In the data analysis of the hot-wire studies, a Melbourne category was derived for each station. These categories are shown on Figures III-C-3.

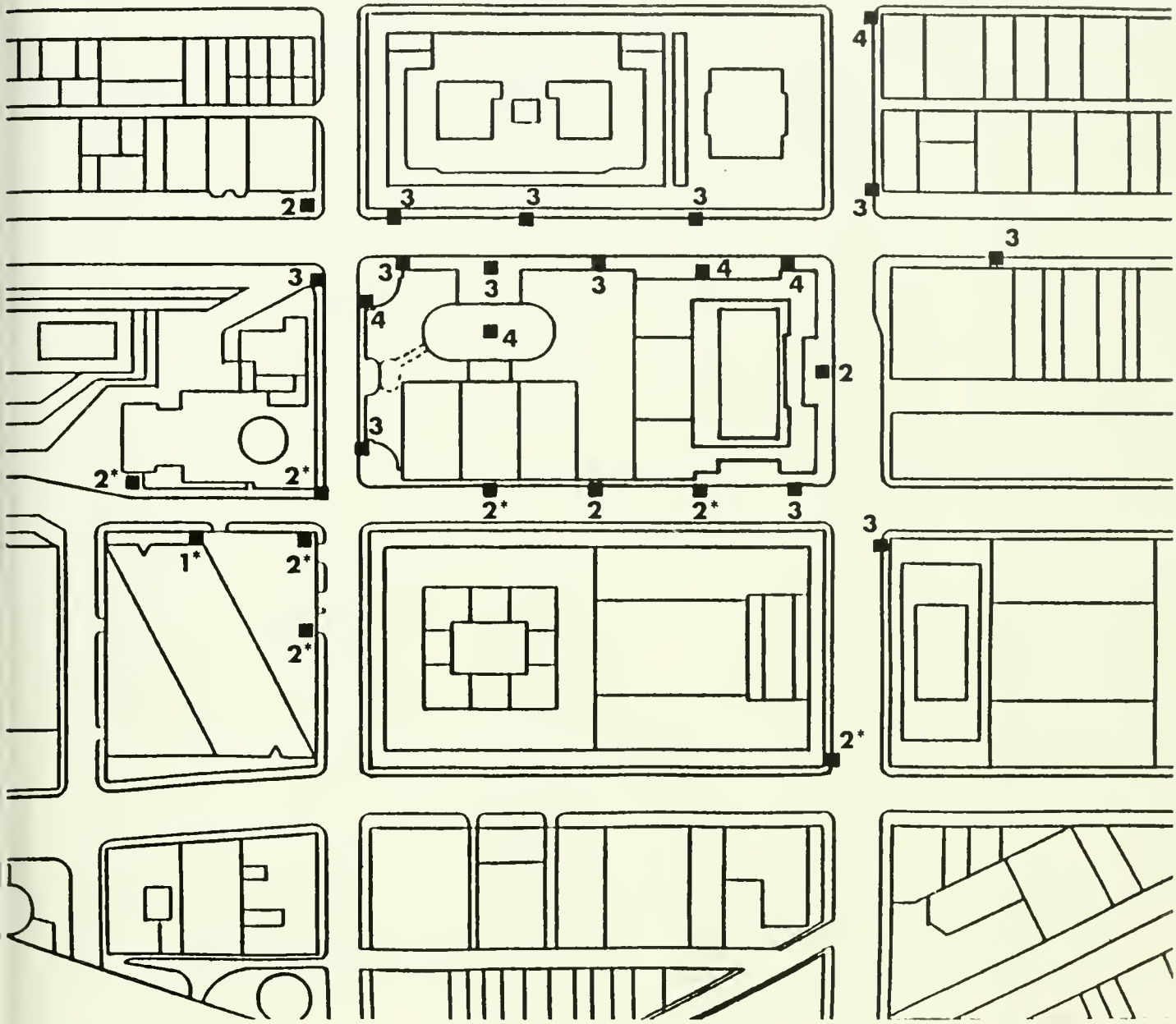
-- BRA Guideline

In addition to the Melbourne ratings, the Boston Redevelopment Authority (BRA) has established a guideline velocity based upon the effective gust velocities. The guideline establishes a maximum effective gust velocity of 31 mph not to be exceeded more than one percent of the time. This condition is usually referred to as the 100-hour return period effective gust velocity since its frequency of occurrence is anticipated to be once in every 100 hours. In terms of equivalent average velocity, the BRA guideline velocity is 22 mph.

3. Results

Twenty-eight stations were tested for pedestrian-level wind conditions in the vicinity of the Reduced 500 Boylston Street Project. In general, the data analysis revealed a Build condition with relatively comfortable pedestrian-level winds. Of the twenty-eight stations studied, sixteen recorded winds in Melbourne's safe and comfortable range (see Figure III-C-3). Five stations recorded velocities in Category 4, comfortable for short periods of standing and eleven stations experience wind levels corresponding to Category 3, comfortable for walking. Ten stations fell within Melbourne's Category 2, uncomfortable for walking, however, six of these stations recorded velocities in Category 2 when tested prior to commencement of project construction. Only one station reached the threshold for Category 1, unacceptable and dangerous, but this station also fell within Category 1 when tested prior to commencement of project construction.

Of the twenty-eight stations tested, only eight stations exceeded the BRA velocity for equivalent average of 22 mph. Five of these stations, those nearest the John Hancock Tower, also exceeded the BRA criteria when tested prior to commencement of project construction.



SOURCE: WBWT

Reduced 500 Bolyston St. Project Melbourne Categories

LEGEND:

1 – Unacceptable and dangerous
2 – Uncomfortable for walking
3 – Comfortable for walking
4 – Comfortable for short periods of standing or sitting
5 – Comfortable for long periods of standing or sitting
* Exceeds BRA guideline

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0 100 200
SCALE IN FEET

Fig. III–C–3

TABLE III-C-1
REDUCED 500 BOYLSTON STREET PROJECT

Station	Equivalent Average Velocity (mph)	Melbourne Category
1	12.6	4
3	13.5	4
5	15.5	3
7	17.4	3
9	16.3	3
10	13.4	4
12	18.9	3
14	23.2*	2
15	20.1	2
16	23.3*	2
17	16.9	3
19	20.2	2
26	14.4	4
31	18.9	3
33	13.4	4
38	17.5	3
39	16.1	3
40	18.2	3
48	20.7	2
57	17.0	3
59	24.4*	2
62	26.2*	2
66	30.18	1
69	26.5*	2
73	24.2*	2
87	22.3*	2
94	17.2*	3
104	15.3*	3

* Exceeds BRA guideline velocity of 22 mph.

D. SUBSURFACE CONDITIONS

1. Introduction

An evaluation has been made of the potential impacts of constructing the Reduced 500 Boylston Street Project foundations and below-grade parking structure on adjacent structures and area groundwater levels. The proposed construction consists of three parking levels below-grade which encompass the entire site.

2. Proposed Foundation Construction

The foundation systems and below-grade construction procedures for the Eastern Component, will be similar to those of the Western Component as presented in the BRA Environmental Impact Reports. The buildings Eastern and Western Components will be supported by reinforced concrete footing or mat foundations. Friction piles will be required to resist buoyant forces below the low-rise building elements. The excavation conditions for the Eastern Component are expected to be similar to those for the Western Component, as described in the BRA Environmental Impact Reports. It is probable that a reinforced concrete diaphragm wall will be used for the lateral earth support system.

The configuration of the Western Component lateral earth support system utilized tiebacks as the primary bracing on three of the four sides, and internal bracing along St. James Avenue. The selection of the most appropriate bracing systems for the Eastern Component will be made during final design of the lateral earth support system. It is anticipated that a combination of tiebacks and internal bracing will again be used.

3. Conclusions

The proposed below-grade structures and probable construction procedures for the Eastern Component are essentially the same as those anticipated for the 500 Boylston Street Project and described in the BRA Environmental Impact Reports. The procedures are the same as those being used for the Western Component which is currently under construction. Based on the excavation performance during Western Component construction, the information provided for the 500 Boylston Street Project, as related to geotechnical issues and described in the BRA Environmental Impact Reports, are applicable to the Reduced 500 Boylston Street Project.

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